APRIL 1957

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers

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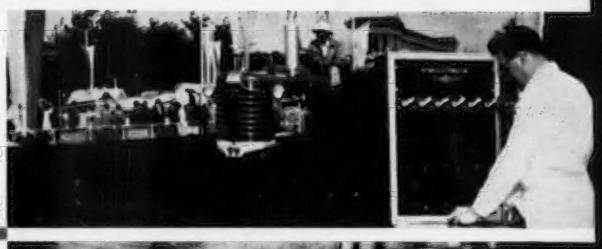

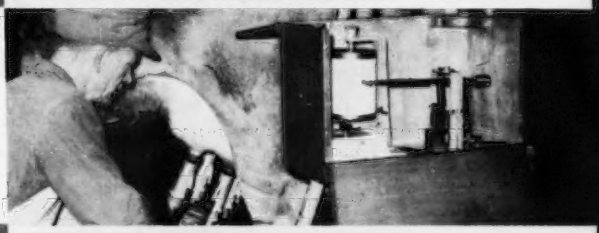

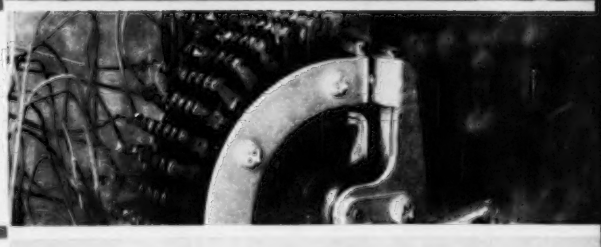

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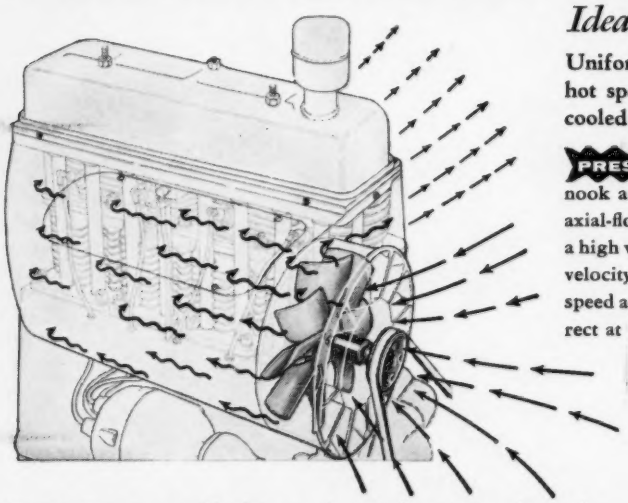

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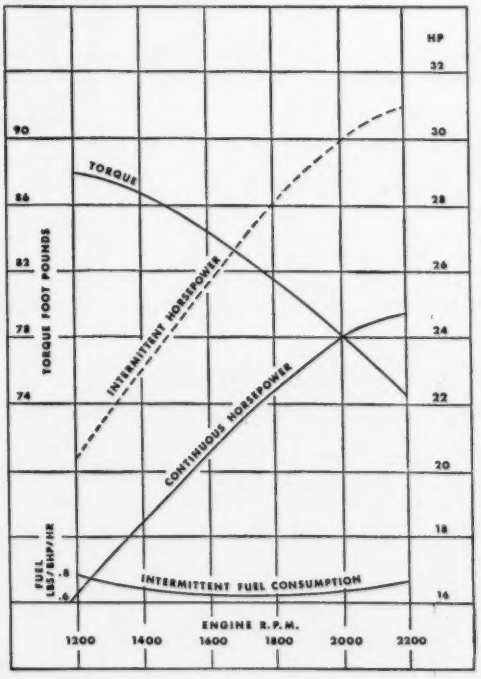

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Established 1920

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Looking Ahead . . .

"Looking to the Future" has been chosen as the official slogan for the Golden Anniversary Meeting of ASAE to be held at Michigan State University, June 23 to 26. During general sessions, top notch speakers from industry, government and education, will report on present and past developments in the field and will emphasize *looking to the future.*

Ross Moore, director, USOM to Bolivia, The Institute of Inter-American Affairs, American Embassy, La Paz, will speak during the general session Monday morning, June 24. The theme will be International Agriculture—Food and Fiber—The Role of the Engineer. A second speaker has not been announced.

The second general session will be held Tuesday morning, June 25, and will feature Manpower and Energy. Arthur S. Flemming, president, Ohio Wesleyan University and formerly director, Office of Defense Mobilization, and Philip Sporn, president, American Gas and Electric Co., New York, will share the rostrum.

On Wednesday afternoon, June 26, preceding the President's Annual Address by Roy Bainer, P. D. Sanders, editor, *Southern Planter,* will speak on The Advancing Front of Science. John L. McCaffrey, chairman of the board, International Harvester Co., will continue the futuristic theme in his address as Annual Banquet speaker, Wednesday evening, June 26. Other outstanding speakers are scheduled for the technical sessions. A report on the technical program will appear in the May issue.

ASAE members are indebted to the Meetings Committee for diligence in obtaining an outstanding program. The Meetings Committee is headed by Walter M. Carleton, who proposed the plan adopted this year to hold one-half day general sessions each day during the convention. Other members of the committee are L. G. Kopp, F. J. Reynolds, J. G. Sutton, R. R. Mauney, C. G. E. Downing and E. T. Swink. Further assistance was given by A. W. Farrall, chairman of Local Arrangements Group and F. W. Peikert, chairman of Committee on Student Branches.

Special exhibits, too, will be dedicated to the future. A model of an atomic power plant, an air conditioned tractor, fuel injection systems for farm power units, as well as solar powered equipment, will be on display. The Golden Anniversary slogan implies that the accomplishments of the past 50 years are merely reference points for aligning our sights for the next 50 years.

MEMBERSHIP STATUS

"50 Hundred Members in Our 50th Year"

This slogan was originated by ASAE President Roy Bainer during the 49th Annual Meeting in June.

January 31, 1957	4681
February 28, 1957	4737
March 31, 1957	4719*
Applications being processed . .	229

Usually complete processing requires about two months after application has been received by ASAE Headquarters

*A decline in membership during the month of March resulted from resignations received following the second billing for dues.

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YOU SAVE TIME and trouble on your assembly line when you use BCA pre-lubricated package units for ball bearing installations on farm implements ... because they are easy to install.

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BCA package units combine the bearing, its housing, and an effective seal in a single rugged unit that is lubricated for life.

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BCA pioneered the use of pre-lubricated package unit ball bearings for agricultural implements ... can help you reduce manufacturing costs and improve implement performance. Bearings Company of America Div., Federal-Mogul-Bower Bearings, Inc., Lancaster, Pa.

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Pioneers of pre-lubricated *package unit* ball bearings for agriculture

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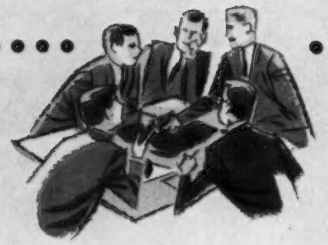
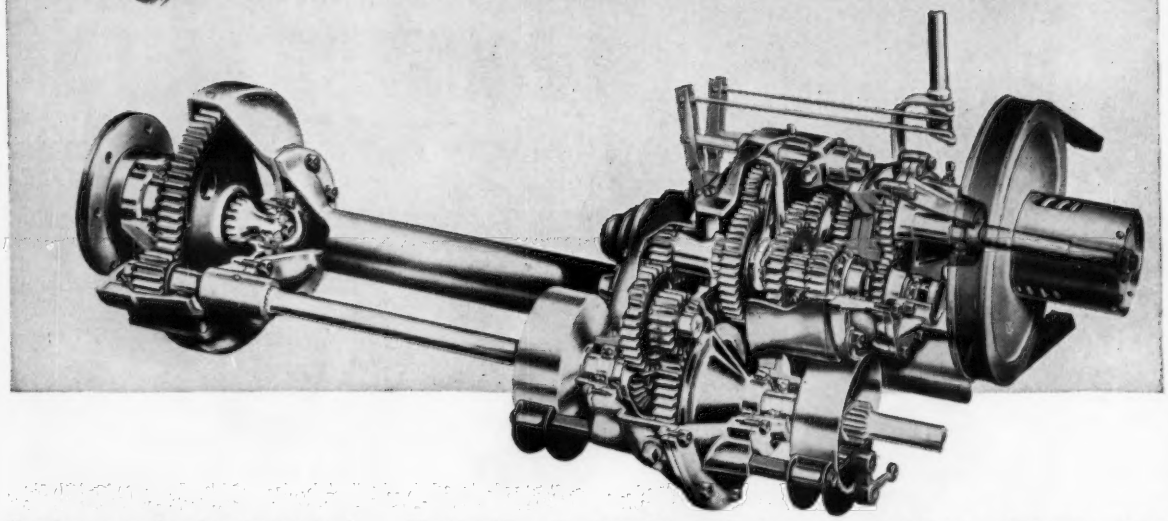
DO YOU HAVE THE 50 YEARS EXPERIENCE



needed to build this special driving assembly?



It takes more than just money to design and build special driving assemblies for power farming equipment. It takes years of power transmission experience—an extensive background in research and development—facilities tailored to meet all special needs—and, most of all, engineers and other manpower trained to solve the particular and intricate problems of providing the right kind of driving assembly for specialized self-propelled farm vehicles.

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If you are faced with problems in designing or building self-propelled farm equipment, it would be a wise move to call in your TDA engineers. The special component that might be a "bottleneck" may turn up as a standard item in the long list of Timken products. If it requires a custom job—you can be sure TDA's farm equipment specialists can design it to exact specifications and build it for less.

Call TDA today! TDA engineering specialists will find the answer to your driving assembly problems.

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Call your local CHAIN Belt Man or write CHAIN Belt Company, 4680 W. Greenfield Ave., Milwaukee 1, Wis. Our engineers will be happy to discuss your chain selection and application problems with you.

CHAIN BELT COMPANY

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DURKEE-ATWOOD's *Little Professor reports . . .*

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for as little as 45¢ per ton!"

One man . . .

harvests 3 to 5 acres per day . . .

delivering up to 100 tons . . .

of *clean topped* beets!

The MARBEET Sugarbeet Harvester uses DURKEE-ATWOOD V-belts!

Blackwelder engineers saved beet farmers plenty of money when they designed the MARBEET. Now in use across the U.S. and abroad, this rugged machinery harvests *all* the beets, large and small, and delivers them *clean*. The MARBEET's unique power transmission and take-off network calls for top-flight performance. That's why Blackwelder engineers called on Durkee-Atwood for assistance in designing the rugged but gentle, foolproof and efficient transmission system. And that's why the MARBEET uses tough, long-lasting Durkee-Atwood V-belts exclusively . . . to keep beet harvesting costs low . . . even under wet and adverse conditions. Call on D-A . . . let Durkee-Atwood V-belt engineers help *you* with tough transmission problems.

Blackwelder Engineers also use Durkee-Atwood V-belts for this completely portable Schmidt Ditch Pump

High efficiency at low maintenance cost is achieved in this completely portable self-contained unit through the use of Durkee-Atwood Multiple V-belts. One man can set up the pump in 5 minutes anywhere, ready to deliver up to 3200 G.P.M. from depths varying from 3 to 9 feet. Another example of how Durkee-Atwood V-belts help deliver peak performance. Let D-A engineers help *you* with *your* transmission design.

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Report to Readers . . .

TOWARD CLOSER USER-MANUFACTURER COLLABORATION IN CONSIDERING IMPROVEMENTS IN FARM MACHINERY

At the instance of the Farm Machinery Committee of the California Farm Bureau Federation, members of the Committee met with representatives of the Farm Equipment Institute at Davis in January "to explore the opportunities for closer cooperation" between users and manufacturers in developing and supplying farm equipment to best meet over-all farm requirements. As the basis for discussion at this meeting, the Committee had prepared a thoughtful statement embodying a list of items which it believed called most urgently for attenion. The need for standardization of tractor controls was specially emphasized. Mention was made also of a number of trends in farming practices that will influence machine design. The Committee's approach was constructive, and doubtless it found industry representatives open-minded to its proposal for closer collaboration . . . . If well planned and implemented, such a program could develop into an activity very much worth while for both users and manufacturers of farm equipment. . . . Since research programs and results would be essential to the success of such activity, an important third participating group would be the agricultural engineers in the state experiment stations and USDA. . . . Thinking still further, the success of this whole idea would depend largely on the organizational setup required, and here is where the farm organizations, FEI, ASAE, and perhaps others, through joint committee arrangements could cooperate to make the over-all operation feasible and worth while.

RESEARCH DEVELOPMENT OF TANDEM TRACTOR CONTINUES UNDER EXPANDED PROGRAM

Following a start at Iowa State College, W. F. Buchele is expanding, at Michigan State University, his development work on the tandem tractor. He and a graduate assistant, David Green, are now designing control means and determining the drawbar pull and performance of the double-motored, four-wheel-drive tractor. . . . These agricultural engineers have set out to develop fast-coupling equipment for the front wheels and tandemizing kit. They aim to develop a large-tractor combination for pulling heavy loads which, when the two units comprising the tandem are uncoupled, will make available two separate power units for handling lighter loads. . . . This typically agricultural-engineering research project will be watched with interest by farmers, by the farm equipment industry, and by manufacturers with a weather eye to expanding OEM business.

"LAND LEVELING," "LAND SMOOTHING," OR "LAND FORMING"?

In a blurb here last month, the first two of these terms were used, but Irwin L. Saveson, project administrator (SWCRB, ARS, USDA) at Baton Rouge, La., in a paper recently before the Southeast Section of ASAE, appears to prefer "land forming," which would seem to be the more appropriate term for general usage. . . . Purpose of "land forming" is to provide a uniform surface to facilitate even movement of surface water (with, of course, minimum erosive effect). The practice was developed in the arid section of the country for the application of irrigation water, and is now moving into humid areas to facilitate both removal of excess rainfall (by surface drainage) and supplemental irrigation. . . . The practice of land forming gives rise to some new soils and engineering problems, including the necessary operating equipment, but the development is proceeding apace. It is a reasonable prospect that wide application of the practice will result as its possibilities become more generally recognized.

NEW CORN STORAGE IDEA AS A STRAW IN THE WIND

Government and private loan officials, who deal with payments for on-the-farm crop storage, have become more insistent that farmers provide reasonable assurance that crops will not deteriorate during storage. Apropos of this, a new idea for corn storage that one manufacturer of factory-built farm structures has developed appealed to our fancy. . . . One of his products is a circular corncrib built of No. 1 gage wire mesh. He has devised a new feature, as optional equipment for this crib, consisting of a 32-inch band of sheet steel placed around the crib under the eaves, which serves to protect the open area that develops at the top of the crib when the corn in storage settles. . . . Not only does this steel band guard against accumulations of ice and snow in the crib, but it also protects the crop from feeding and nesting birds. . . . Apart from the value of this little gadget in achieving better on-the-farm storage conditions, it is typical of the many straws in the wind these days of the trend toward well-engineered, factory-built farm buildings, along with greater attention to developing components designed to increase the versatility and efficiency of these buildings. It is not too much to expect that in the coming thirty years, more or less, this development will come close to matching that of the general-purpose tractor and its complement of operating tools in the past thirty years. . . . Putting it another way, in order for mechanized or engineered farming to attain maximum success, it is essential that there be a good balance in the development and use of efficient and economical operating equipment of all kinds, both structural and mechanical.

RATING 50 YEARS OF PROFESSIONAL DEVELOPMENT IN AGRICULTURAL ENGINEERING

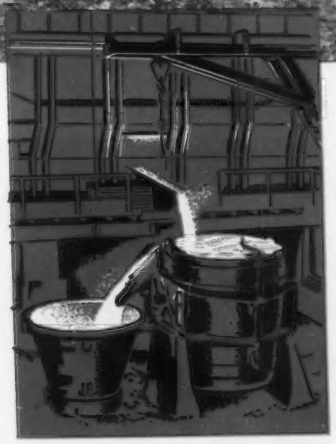
How do agricultural engineers rate developments of the past 50 years (1907-57) in this golden anniversary year of their professional society (ASAE)? The agricultural engineering department at Michigan State University decided to find out, and accordingly surveyed chief engineers of industry and heads of college agricultural engineering departments. Report of the survey in more detail has not yet been released, but here is a rundown of ratings of PROFESSIONAL developments, in the order of their importance, given by these engineers: (1) development and accrediting of the professional curriculum, (2) graduate programs, (3) Nebraska tractor test program, (4) soil tillage research projects, (5) extending benefits of progress achieved here to other countries through technical-aid programs, (6) recognition of agricultural engineers and the profession generally, and (7) dissemination of technical programs through national and state extension services. . . . It is significant that the rating given No. 1 above was more than 2.5 times that given the next ranking item.

RATING 50 YEARS OF TECHNICAL DEVELOPMENT IN AGRICULTURAL ENGINEERING

As part of the MSU survey briefly reported above, the same group of engineers was asked to rate the more TECHNICAL developments of the past 50 years in what they considered to be the order of their importance. Following are the results of this part of the survey: (1) development of the general-purpose tractor, (2) improvement in farm living by electric equipment, (3) refinement of the agricultural tractor, (4) greater productive use of electric power, (5) progress in soil erosion control, (6) putting tractors and implements on pneumatic tires, (7) adaptation of the grain combine, (8) general improvement of farm machinery, (9) soil and water conservation, (10) development of hydraulic controls, (12) definition of optimum environmental conditions for livestock shelters and crop storages, (13) development of sprinkler irrigation, (14) development of the mechanical power take-off, and (15) improvement in farm house design.

LaBelle discs stay sharp longer...

Many John Deere implements like this Pick-up Disk Harrow are equipped with Crucible LaBelle discs.



. . . *this field advantage 'is built in here!*

When you specify Crucible LaBelle discs, you insure better performance in the field. Here's why:

At Crucible, *disc* steel is as much a special purpose steel as *tool* and *stainless*. In every phase of production, from melting through fabricating, special steps are taken to produce LaBelle quality. One example: grinding is done prior to heat treating to insure a better edge. All this is done by Crucible's specialty steelmen . . . to *build-in* LaBelle's field advantage: a longer lasting edge that performs better in any type of soil.

Crucible LaBelle discs are available for any make of plow or harrow . . . or for any soil condition. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

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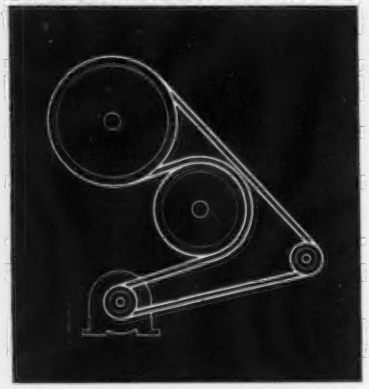
V-Belt Designer's Notebook

A special V-Belt Engineering Service to help you cope with 7 Drive Problems created by space-saving modern design

A checklist of V-belt drive designs which require specialized engineering. With a description of the compensating characteristics which can be built into special Dayton V-Belts. Sources: Case histories from the files of the Dayton Special V-Belt Engineering Service and "The Dayton Handbook of V-Belt Drive Design and Selection."

Here's a typical example of efficient, compact, modern design—an automatic washer with a Dayton V-Belt Drive.

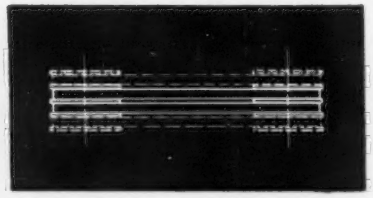


Note that it imposes three design requirements, (1) a torturous back bend (2) sub-diameter pulleys (3) a limited tension take-up area. Yet the design is efficient because Dayton V-Belt engineers developed a belt especially adapted to these three punishing conditions.

You'll find similar examples in machine tools, agricultural machinery and wherever drive space is limited. You've seen them yourself—the designs which dictate sheave misalignment, back-side idlers, underbelting; plus others which use V-Belts as a clutch and which impose excessive shock loads on the belt.

HERE ARE THE MAJOR CONDITIONS WHICH AFFECT V-BELT PERFORMANCE

Underbelting

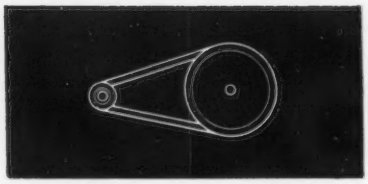


Underbelting is found where space is limited or as a result of very low belt speeds. It will cause belts to slip, run hot and wear out very quickly. A temporary cure, commonly employed, is to over-tension the belt — thus throwing excessive loads on the bearings.

The design requires a high capacity belt with extra-strength cords found in Dayton's Super-Thorobred series or, in difficult cases, belts with both a high coefficient of friction and extra strength like the raw-edge Dayton Cog-Belt.

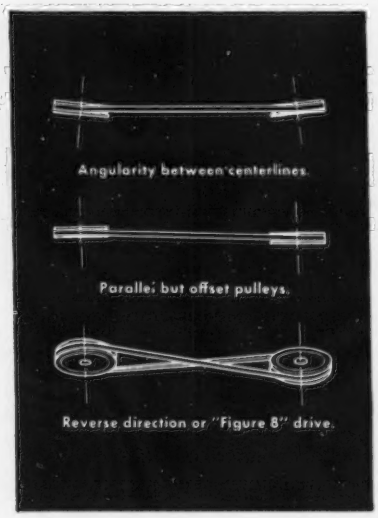
Sub-diameter sheaves

Belts driven by sub-diameter sheaves are inclined to succumb to accelerated flex failure. Tensioning problems are a usual result.



Sub-diameter sheaves require extremely flexible belts for satisfactory service. The required flexibility may be obtained by using thin V-Belts—where drive capacity is not high. When considerable capacity is required, Dayton Cog-Belts will give the most satisfactory performance. Their exclusive design permits exceptional flexibility. Die-cut raw edges provide high coefficient of friction, transmit maximum power from sub-diameter sheave arcs.

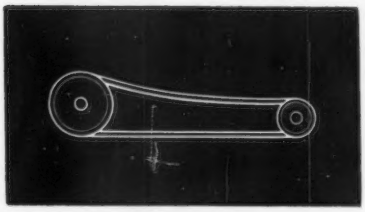
Misalignment



Misalignment causes uneven tension across the face of the belt—producing abnormal belt and pulley wear and uneven bearing loads.

A suitable approach is to use highly extensible cords of the latest synthetic fibers in the strength band of the V-belt. Dayton's Development Engineer can prescribe the material best suited to your needs.

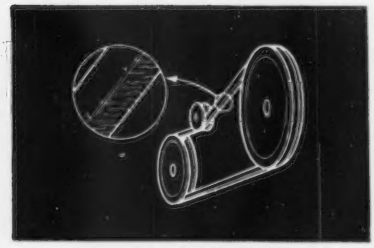
Fixed centers



Proper tension cannot be maintained with fixed centers or where center distance adjustment is inadequate. Without proper tension, belts slip and need frequent replacement.

Dayton V-Belts with low-stretch neutral-axis cords are best suited for applications with little or no provision for center distance adjustment. Still higher performance is gained if the belts have maximum cross-sectional stability which helps keep the belt from seating in the sheave groove.

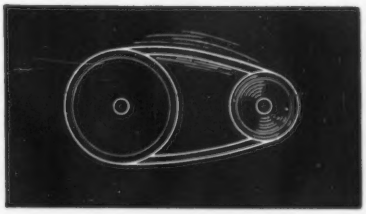
Back-side idlers



Cracks will appear on the under side of the belt, since back-side idlers force the belt to flex in a direction contrary to its construction. Use of spring-loaded back-side idlers may result in belt-snapping.

Where back-side idlers are used to provide tension take-up, they must never be smaller than the smallest pulley in the drive. Dayton V-Belts used in this case employ tension or stretchy type materials in the compression section and have a relocated neutral axis.

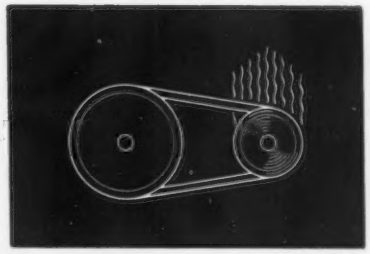
Excessive shock



Excessive shock can cause the belt to snap as well as promote bearing troubles and sheave misalignment.

Belts subject to excessive shock or heavy pulsation require strength band constructions which offer changeable ratios between stress and strain without taking a permanent stretch. Belts with soft cross sections — that will ride up and down in the groove — work well under shock as do wide angle belts. Any of these belts are available from Dayton.

Using as a clutch



V-Belts are ordinarily designed for constant loads and will burn when used as a clutch.

But, belts especially designed for use as a clutch will readily slip when a load is suddenly applied or released. Dayton cover stocks used here have a low coefficient of friction and high resistance to wear.

DAYTON'S SPECIAL V-BELT ENGINEERING SERVICE

Make use of Dayton's Special V-Belt Engineering Service when you encounter any of these designs. Your Dayton V-Belt design engineer is an expert who has devoted himself exclusively to V-Belt Drives. Your design may permit a minor modification which would adapt it to the use of low-cost standard V-Belts. Other standard Dayton V-Belts available for special applications are the Double-Angle V-Belt, the Double Cog-Belt, the Variable Speed Cog-Belt and the Back-Side Idler V-Belt.

With one of the finest research and development laboratories in the industry, Dayton research engineers constantly advance V-Belt knowledge. They develop basic theory, prove the characteristics of the newest compositions and materials available to the rubber industry and test the performance of theoretical constructions. All of this acquired information is at your call when you need a special V-Belt.

Now, while your design is on the drawing board, is the time to call your Dayton V-Belt design engineer. He'll help you select the V-Belt which is tailored to your specific drive. The result — a compact, versatile design which meets all your minimum design requirements and one that will give its users years of trouble-free service.

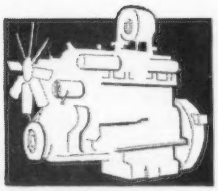
Agricultural Engineers in Atlanta, Chicago, Cleveland, Dallas, Dayton, E. Moline, New York, Rock Island, San Francisco and St. Louis.

Dayton Rubber

THE DAYTON RUBBER CO., AGRICULTURAL O.E.M. DIV., DAYTON 1, OHIO
WORLD'S LARGEST MANUFACTURER OF V-BELTS

If you haven't received your copy of Dayton's authoritative Agricultural V-Belt Product Bulletin A-2024, write for it now. Just give us your name, title, and the address of your firm.

For more facts circle No. 14 on reply card



For every engine, there's a VEEDER-ROOT REV-COUNTER

to prove your product's claims

Rev-Counter for general built-in use. Self-contained case is designed for outside application.

Rev-Counter especially designed for installation in user's housing.

Rev-Counter especially designed for built-in installations.

That's right . . . you can build into your engine a real "performance-prover" that keeps a faithful and complete record of engine use . . . a record that's beyond dispute. These Veeder-Root Rev-Counters *show you and your customers*, at any time, exactly how your equipment is performing up to its guarantee . . . whether they're getting out of it all the service you built into it. These direct counter-readings also show at a glance when routine maintenance is coming due . . . whether servicing is needed . . . and supplies other valuable facts-in-figures.

This 2-way protection is vital not only as a built-in feature of engines, but also of generators, compressors, heaters, refrigerators, high-speed cameras, and what-have *you*?

Veeder-Root Rev-Counters are available with *tachometer take-off* . . . and may be geared to your own engine requirements. Count on Veeder-Root for any assistance you need in designing these Rev-Counters into your product. Write:

VEEDER-ROOT INC., Hartford 2, Conn.

STOCKS OF STANDARD COUNTERS AVAILABLE AT

Greenville, S. C. • Chicago 6, Ill. • New York 19, N. Y. • Los Angeles • San Francisco • Montreal 2, Canada • Offices and Agents in Other Principal Cities

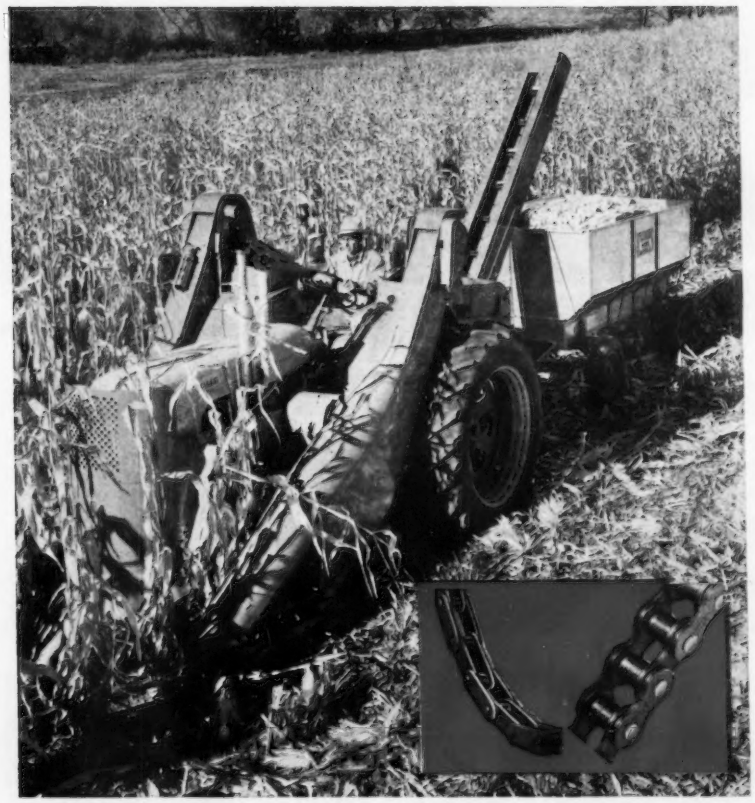
Everyone Can Count on VEEDER-ROOT

"The Name that Counts"

The good name of your machine is LINK-BELT's first consideration . . . TRADE MARK . . . and quality should be your first consideration in the chain you buy

Choose LINK-BELT chain

It's the efficiency-equal of your equipment!



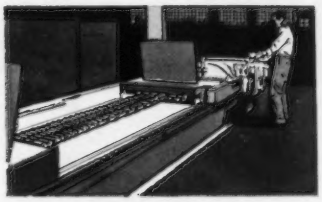
Here's how LINK-BELT tailors drive and conveyor chains for the stresses they'll meet on your equipment

LINK-BELT chain designs are based on needs determined in field tests under actual working conditions. And by combining these results with modern laboratory controls and facilities of the world's largest chain plant, Link-Belt assures you of uniform quality chain for long drive and conveyor life. In addition, Link-Belt's broad line permits unbiased recommendations. Specific horsepower, loading and speed requirements of your equipment can all be satisfied.

Let these broad facilities and experience help protect the good name of your machine. For information, call the chain specialist in your nearby Link-Belt office.

THIS J. I. CASE 420 CORN PICKER incorporates both Link-Belt precision steel roller chain and "AG" chain—each chosen for its ability to satisfy specific operating conditions.

COMPLETE LINE of Link-Belt agricultural chains, sprocket wheels and attachments permits cost-saving specialization—offers the right chain for all your conveyor and drive requirements.



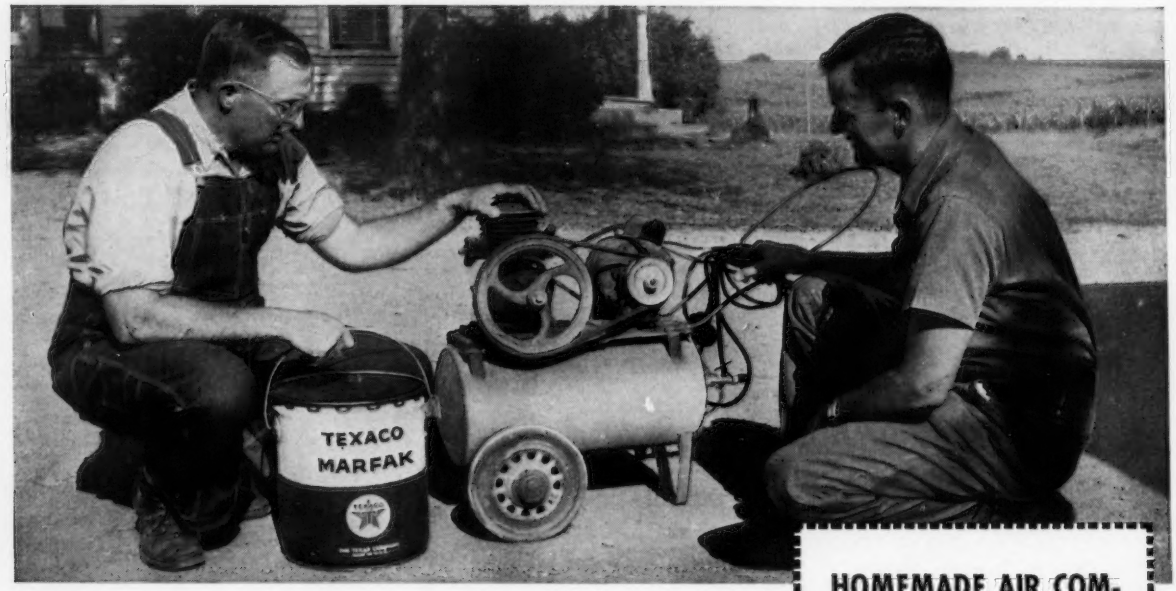
ACCURATE MANUFACTURE and inspection with specialized machines allow mass-production economies. Extensive facilities are ample to meet your production schedules.

LABORATORY CONTROL assures you that each chain meets rigid uniformity specifications. Our modern laboratory continuously explores new refinements to increase chain life.

LINK-BELT

CHAINS AND SPROCKETS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,530



HOMEMADE AIR COMPRESSOR is the ingenious "invention" of Cletus Neuroth, of Marshalltown, Iowa, shown here with popular Texaco Consignee D. E. Edsall (right). He utilized the compressor from an old refrigerator, a section of a discarded hot water tank, and the wheels from a child's wagon.

"Made-it-himself" air pump works fine!

MR. NEUROTH operates a 240-acre farm, raising cattle and pigs in addition to general crops. In his spare time, he bales hay for his neighbors, averaging 20,000 bales a year.

The air compressor saves a lot of time and labor in pumping up truck and farm machinery tires. It also comes in handy for MARFAK lubrication of his machinery. Mr. Neuroth uses other Texaco products, too.

Like thousands of progressive farmers *everywhere* he has found that *it pays to farm with Texaco products*, and he likes the service he gets from Consignee Edsall.

DEPENDABLE TEXACO GASOLINE is supplied to Roy L. Hale of Hood River, Oregon, by Texaco Consignee Joe B. Young. A successful orchardist, Mr. Hale uses Fire Chief gasoline and other Texaco products in his farm operation and appreciates the Texaco on-time, neighborly delivery service he gets from Consignee Young.

NO DISAGREEMENT HERE: Texaco Consignee C. B. Singleton, Jr., and James Crisp, of Trenton, Tennessee, agree that Advanced Custom-Made Havoline Motor Oil wear-proofs truck, tractor and car engines – gives added power, longer engine life, greater gasoline mileage. Mr. Crisp is a real Texaco booster.

IN TOWN OR ON THE HIGHWAY – in all 48 states – you'll find Texaco Dealers with top-octane Texaco Sky Chief gasoline, supercharged with Petrox, for maximum power and to cut engine wear . . . Texaco Fire Chief gasoline at the *regular* price, both 100% Climate-Controlled. Also, Marfak Lubricant and Havoline Motor Oil.

ON FARM AND HIGHWAY IT PAYS TO USE

TEXACO
PRODUCTS

DIVISION OFFICES: Atlanta, Ga.; Boston 16, Mass.; Buffalo 9, N. Y.; Butte, Mont.; Chicago 4, Ill.; Dallas 2, Tex.; Denver 3, Colo.; Houston 2, Tex.; Indianapolis 1, Ind.; Los Angeles 15, Calif.; Minneapolis 3, Minn.; New Orleans 16, La.; New York 17, N. Y.; Norfolk 2, Va.; Seattle 1, Wash.

Texaco Products are also distributed in Canada, Latin America, and Africa.

THE TEXAS COMPANY

Alcoa can help you help farmers

Alcoa® researches farm applications of aluminum continuously. Take buildings . . .

In cooperation with leading agricultural colleges throughout the country, Alcoa has developed nine plans for practical pole-type buildings that can be built at savings up to 75%. More important than first cost are the long-range savings on upkeep and the increased livestock production that result from the animal comfort which aluminum brings.

You can have one complete set of these building plans free by writing for it. In addition, there's a big catalog describing these plans and giving a run-down on the savings and other advantages of building with aluminum.

If you have questions about aluminum on the farm, why not give Alcoa a chance to help you answer them? We'd like to hear from you. Meanwhile, here are some materials you'll be glad to have in your files. Write for them.

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

ALCOA SALUTES

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM FARM PRODUCTS
ALUMINUM COMPANY OF AMERICA

Agricultural Division
Aluminum Company of America
2089-D Alcoa Building, Pittsburgh 19, Pa.
(Please send items checked)

- ☐ One complete set of nine pole-building StePlans.*
- ☐ *Pole Barn Plans Catalog.* Lists Alcoa plans available to farmers.
- ☐ *Pipelines to Profit.* Booklet on portable irrigation.
- ☐ "Right as Rain" 28-minute sound-color film on portable irrigation.†
- ☐ "Barn Raising, U.S.A." 18-minute sound-color film on pole barn construction using aluminum roofing and siding.†
- ☐ Alcoa Farm Gate literature. Facts about aluminum gates.

*Trademark of Aluminum Company of America
†Films may be borrowed for public showing. Specify dates wanted

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WHAT IS YOUR PARTS PROBLEM?

The RIGHT solution can save you money

. . . and chances are, Aetna can provide it. Many of the production and application problems of parts which are troublesome to you today, may have already been successfully studied and resolved by our design and application engineers. From hundreds of case histories they can give you valuable counsel—help you make certain that the vital parts that go into your products will provide the dimensional accuracy and stability so essential for sustained peak efficiency and longest life expectancy.

Versatile facilities enable Aetna to do a complete job in parts for O.E.M. customers—from research through manufacturing—with all the advantages of single source control and responsibility. Why not outline YOUR parts problems for our study and proposals.

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Division of Parkersburg-Aetna Corporation

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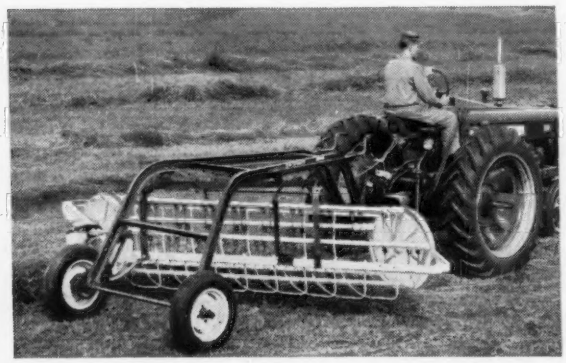
Aetna

Standard and Special Ball Thrust Bearings • Angular Contact Ball Bearings • Radial Ball Bearing Mounted Units • Special Roller Bearings • Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings • Miscellaneous Parts

OVER 99,000 USERS AGREE

It's the world's most dependable baler!

Cut square corners easily . . . hook up fast with the new McCormick No. 32 trailing mower. Hydraulically raised five, six, or seven-foot cutter bar protected by 45-degree breakaway. Heavy-duty precision drive and pitman assure seasons of smooth-running operation.



Get gentle, high-speed raking! Rake all your hay when it's ready, season after season with the new McCormick No. 15 side-delivery rake. Shortest possible hay travel means gentle, leaf-saving action at fastest raking speeds.

McCORMICK® No. 45

Proved and approved by over 99,000 satisfied users! The light-running McCormick No. 45 is *first choice* of more farmers and custom operators than all other family-size balers combined! It *pioneered* low-level pickup and floating auger for uninterrupted feed and big daily tonnage . . . performance yet unequalled!

You bale *all* crops, long or short. Hold desired density automatically with optional hydraulic regulator. You get positive tying without frequent adjustment . . . firm ties close to the bale prevent buckling. Non-stop plunger slices each charge . . . packs bales uniformly. This helps your No. 45—pto or engine drive—match tonnage with outfits claiming 30 to 50% greater capacity.

FREE! McCormick baler twine to tie your first 1,000 bales!

You get 2 bales of high-quality McCormick baler twine FREE with your new Mc Cormick twine-tie baler. Enough to tie 1,000 average 36-inch bales of hay! We make this offer to prove to you "your baler works better" with true sisalana McCormick twine . . . you bale faster, smoother . . . *tie your hay at lower cost per ton!*

Ask your IH Dealer for proof that it pays you to own a McCormick No. 45 for as little as two day's baling a year. Buy through the IH Income Purchase Plan.

SEE YOUR
INTERNATIONAL HARVESTER
DEALER

International Harvester products pay for themselves in use—McCormick Farm Equipment, Farmall and International Tractors . . . Motor Trucks . . . Construction Equipment—General Office, Chicago 1, Ill.

✓ happy balance between dependable performance and moderate cost

ROLLWAY
STEEL CAGE
ROLLER BEARINGS

Tru-Rol *precision, steel-cage, heavy-duty bearing with contoured guide lips assuring true right-line rolling, maintained roller alignment and thin oil film.*

● Rollway's *TRU-ROL* Steel-Cage Bearings afford wide latitude in balancing *dependable* performance, *long* life, and *high load* capacity against *moderate* cost. They rate high in any comparison on a cost-performance basis.

A choice of stamped steel retainers with contoured guide lips, or steel segmented retainers assure true rolling and an evenly distributed *thin* oil film — *big factors in reducing power losses and heating.*

"Crowned" Rollers Relieve End Stress

TRU-ROL offers the extra advantage of a finish-ground "crown" radius on the roller ends. That relieves high end-stress and insures uniform load distribution over the entire length of the roller. The result: *TRU-ROL* Steel Cage Bearings carry heavier loads over longer periods without excessive end-fatigue. They are less affected by slight misalignment or shaft deflection.

Investigate *TRU-ROL* Steel Cage Roller Bearings before selecting any bearing in the medium price range.

TYPE D

Rollway Metric Series Steel Cage Roller Bearings

● Rollway Metric Series Steel-Cage Bearings offer the greater load capacity of solid cylindrical rollers, plus the true right-line rolling of trunnion rollers turning in a rigid steel cage. There's no roller skew, no pinch out, no cam action. Design permits maximum bearing capacity . . . within small space . . . at moderate cost.

Let Rollway Help...

Our complete engineering and metallurgical services will gladly work with you on your problem. Simply write or wire any sales office. No cost. No obligation.

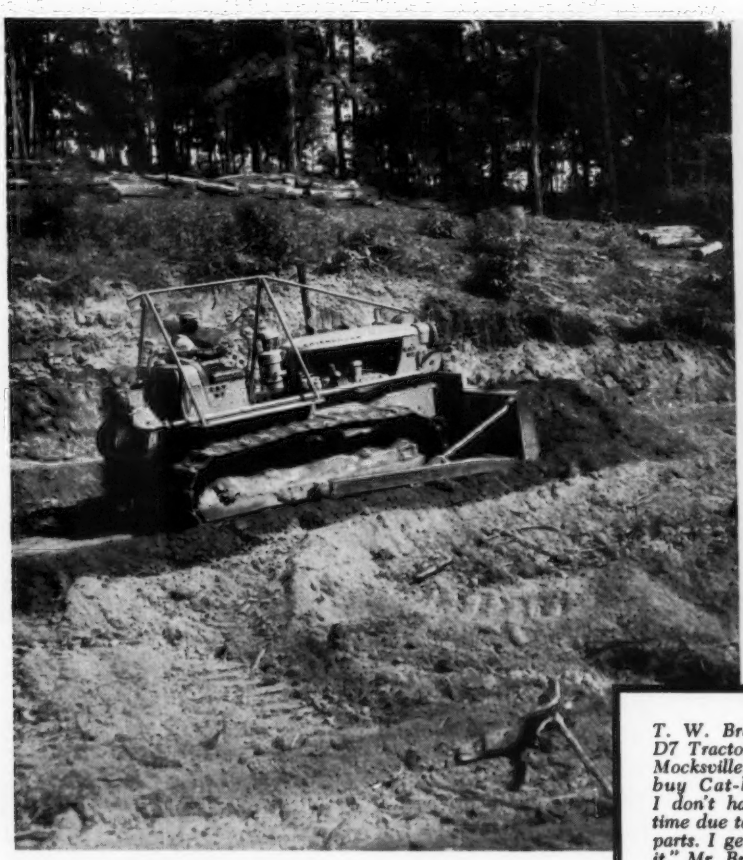
Rollway Bearing replacements are available through authorized distributors in principal cities. Consult your classified phone directory.

ROLLWAY BEARINGS

COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

ROLLWAY BEARING CO., INC. SYRACUSE, N.Y.
584 SEYMOUR STREET

ENGINEERING OFFICES: Syracuse • Boston • Chicago • Detroit • Toronto • Pittsburgh • Cleveland • Milwaukee • Seattle • Houston • Philadelphia • Los Angeles • San Francisco



Here's the tractor that will make you and another man a good living!

T. W. Brown, owner of the CAT D7 Tractor shown here working near Mocksville, North Carolina, says, "I buy Cat-built equipment because I don't have to worry about down-time due to breakdowns or waiting for parts. I get good service when I need it." Mr. Brown also owns another D7, D6 and a No. 12 Motor Grader.*

A message to the man who now owns one tractor, but wants to grow: Demand for the services of farm power contractor work is increasing. Perhaps you had to turn down customers last fall because you couldn't get to them. Maybe there's some turnpike or watershed work in your territory that you'd like to get. Perhaps you've thought of adding another machine, but decided against it because of the problem of getting a dependable operator, plus the care and headaches of keeping two tractors working.

If this is all that's holding you back, listen: Make that new tractor a Caterpillar Diesel Tractor, and you can cross a lot of your worries off the list! Right away your Caterpillar Dealer gets you off to a good start. His men know your type of work and will recommend exactly the right machine with proper equipment for your jobs. Then they check over your machine before and after delivery to be sure it is performing at 100% of its efficiency. They'll help you familiarize yourself and your operator with everything about the tractor . . . even help train your men. Then you can get set for thousands of hours of trouble-free service. You can practically bank on going 10,000 hours before overhaul. You can rely on your Caterpillar Dealer to be on hand with original Cat parts and service when and where you need them. You can take your equipment anywhere in the world, if you wish, and still know that nearby there's a Caterpillar Dealer ready, willing and able to serve you.

CATERPILLAR TRACTOR CO., Peoria, Ill., U. S. A.

FREE BOOKLETS FOR YOUR CUSTOMERS:
We'll gladly supply you with a quantity of our newest booklet, "Community Watersheds," to help you generate interest in watersheds among your customers and leaders in your area. Write us, telling how many you need. Address: Caterpillar Tractor Co., Dept. AE47, Peoria, Ill., U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

LAND DEVELOPMENT PARTNERS:
CONSERVATIONISTS • FARM POWER CONTRACTORS
YOUR CATERPILLAR DEALER

WHERE POWER STEERING REALLY COUNTS

—making the job easier for the man who rides a tractor

Power steering is every bit as desirable for farm tractors as it is for passenger cars—*and for more and better reasons.*

By taking the tiresome muscle work out of steering, it makes tractor work not only an easier task but a far more efficient operation.

For example, power steering eliminates wheel fight and shock even over the roughest ground; it holds the wheel firmly against the furrow when plowing; it permits the tractor to be controlled by simply "pointing" where the driver wants it to go.

Also, short turns become an easy, one-hand job even when the tractor is standing still.

Any way you look at it, power steering saves time as well as work, and that's exactly why power steering on farm tractors is destined to be the next step forward in farming efficiency.

Bendix* Power Steering is a performance-proven product designed and engineered by Bendix, foremost producer of power steering and brakes for the automotive industry.

It is used with a conventional steering gear and is adaptable to existing steering linkage, permitting tractor manufacturers to make production-line installations without costly or extensive engineering changes.

Manufacturers interested in adding Bendix Power Steering to their present list of sales features are invited to write for further details to BENDIX PRODUCTS DIVISION, SOUTH BEND, INDIANA. *REG. U. S. PAT. OFF.

Export Sales and Service:
Bendix International Division,
205 East 42nd Street, New York 17, N. Y.

Bendix PRODUCTS DIVISION South Bend IND.

Bendix
AVIATION CORPORATION

Farm implement dealers cooperated with the Watonwan County, Minn., Safety Council, to stress the dangers of unguarded power take-off shafts in this county fair exhibit. "Empty chairs" mean "empty tractor seats" too!

Photo courtesy of
Watonwan County Safety Council

BLOOD BROTHERS *Integral*

Safety-Shielded Drive Lines help farm implement dealers keep their customers safe!

For humanitarian reasons—and wise business practice as well—it pays to increase the customer's safety in every possible way. As proof of great progress in the farm implement field, Blood Brothers reports an increase of over 300% in the demand for Integral Safety-Shielded Drive Lines during the past year alone!

Some manufacturers are supplying Integral-Shielded Drives exclusively on *all* power take-off implements they build. This trend to greater safety helps implement builders—dealers—users—everyone!

Saleswise, Blood Brothers Integral-Shielded Drive Lines are helpful too. They offer a strong "plus" selling feature that *proves* you place the farmer's best interests *foremost.* Designed to avoid careless or absent-minded removal, they'll be *in place* to protect implement operators at all times.

If you *build* implements, write for information on the sizes you need.

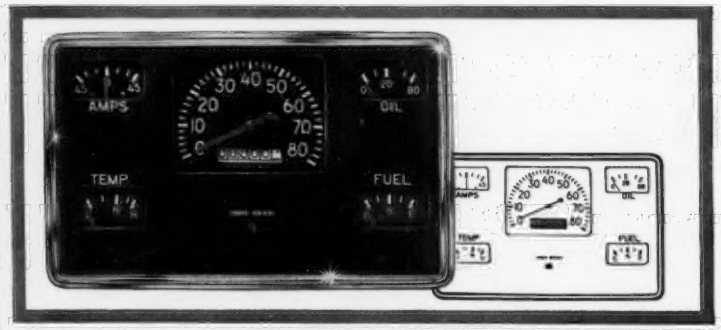
FOR FARM IMPLEMENTS, MORE BLOOD BROTHERS UNIVERSAL JOINTS ARE USED THAN ALL OTHER MAKES COMBINED

TAKES POWER AROUND CORNERS

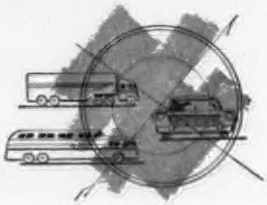
BLOOD BROTHERS MACHINE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
ALLEGAN, MICHIGAN

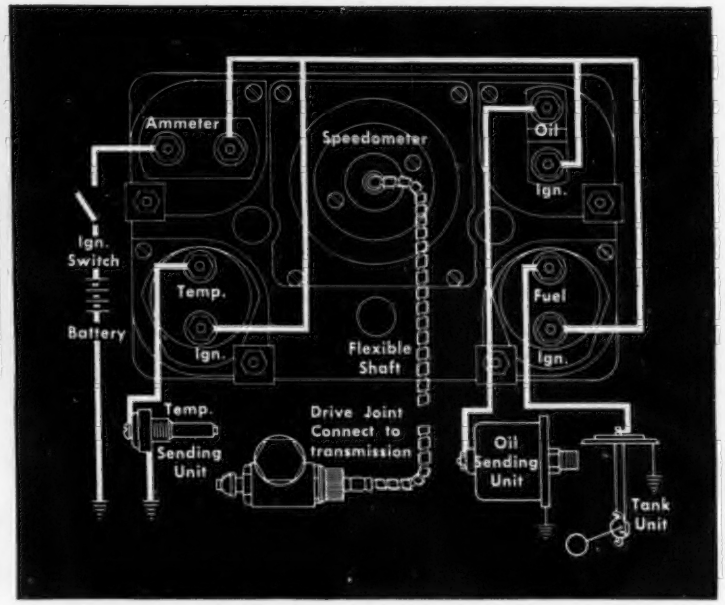
UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

How STEWART-WARNER can help you plan a complete INSTRUMENT PANEL



Stewart-Warner Panel 602-H. A stock panel now used by leading truck manufacturers. Highly flexible—can be fully electric or combination of electric and mechanical.





Typical Hook-up for Panel 602-H. Above panel includes mechanical speedometer, electric gauges, complete with sending units.

. . . from designs to finished panels . . . custom-made or stock models —for cars, trucks, buses and engines!

At every step of design—from styling of panel to choosing drive equipment—Stewart-Warner offers you the widest selection . . . plus engineering teamwork unmatched by any other manufacturer!

Stewart-Warner furnishes the most complete line of individual instruments—speedometers, tachometers, tachourmeters—and gauges of all types. Our engineers will help you combine these in one of our many standard panels . . . or an entire panel can be custom-made to your specifications.

Stewart-Warner—instrument specialists for over half a century—can supply all your instrument needs and drive equipment *from one dependable manufacturing source.* Save money by consulting Stewart-Warner now. . .while your designs are still in the early planning stage and are subject to modification!

For further information, write:

STEWART-WARNER

Dept. V-47, Original Equipment Sales

1840 Diversey Parkway • Chicago 14, Illinois

R B & W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By John S. Davey

Factor of Safety— make it a reality

You can't calculate that with a bolt having yield strength of 4 times the working load you're automatically getting a *safety factor* of 4. Far from it. Only when the bolt is *tightened* to four times working load do you get it.

That's because rigidly fastened members can be externally loaded to the full value of residual tension in bolts without any separation or extra bolt stress.

Suppose you need a bolt for a 5000 lb. working load. For a X4 safety factor, you use a bolt of 20,000 lb. capacity, and tighten it to 20,000 lb. tension. If you tighten to only 10,000 lbs., any external load larger than this causes loosening, and progressive bolt failure from fatigue. So your safety factor is really only 2.

PRODUCTION MAN FOLLOW-THROUGH IMPORTANT

Factor of safety, then, is not established on the drawing board. It can only be put into the product by the shop man with wrench. In short, a bolt is no better than the supervision of its tightening.

A NOTE ON FLEXIBLE JOINTS

This case is different. You tighten such a joint just to working load. So use a bolt capable of this *plus* any added stress *multiplied* by your safety factor.

How to simplify bolt and nut usage

DESPITE their now unified dimensions, "standard" fasteners number thousands upon thousands of different types and sizes. More and more companies are beginning to realize that *usage* simplification offers advantages.

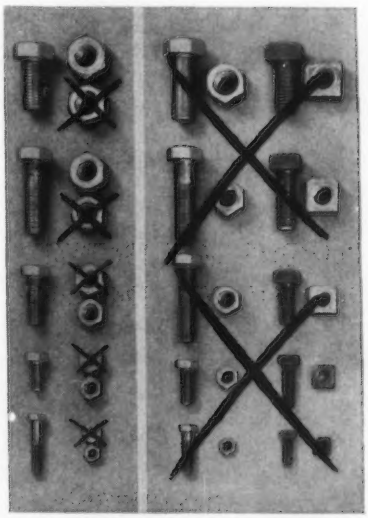
EXAMPLES

A well known electrical manufacturing company finds it no handicap to eliminate all 1/16" bolt sizes above 3/8", thereby simplifying production and purchasing.

One engineering firm eliminated 1700 different fastener items from inventory by determining that the jobs could be done as well by other sizes or types.

SOME SUGGESTIONS

To guide your thinking, RB&W points up the following ways to simplify: (1) Forget thread fits for all but specialized needs — standard "tolerance fits" have thoroughly proved themselves. (2) Why adhere to double thread standard when coarse threads prove stronger and assemble faster? (3) Stick with hex head bolts — they do better jobs than square. (4) It can save money to change diameter or length, rather than to add another item to stock. (5) Two standard physical grades meet most load range requirements — do you really need special alloys? (6) Heavy nuts really belong with larger size bolts — use finished nuts with the smaller sizes.



Here is a graphic display of possible simplification. From a typical array of fasteners, it shows what may be superfluous for meeting the requirements of proper fastening in a great many instances.

RB&W would be happy to enlarge on these facts, and help you simplify fastener selection to get proper joint strength and cut assembly time and inventory. Write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N.Y.

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

High strength bolts save costly crane

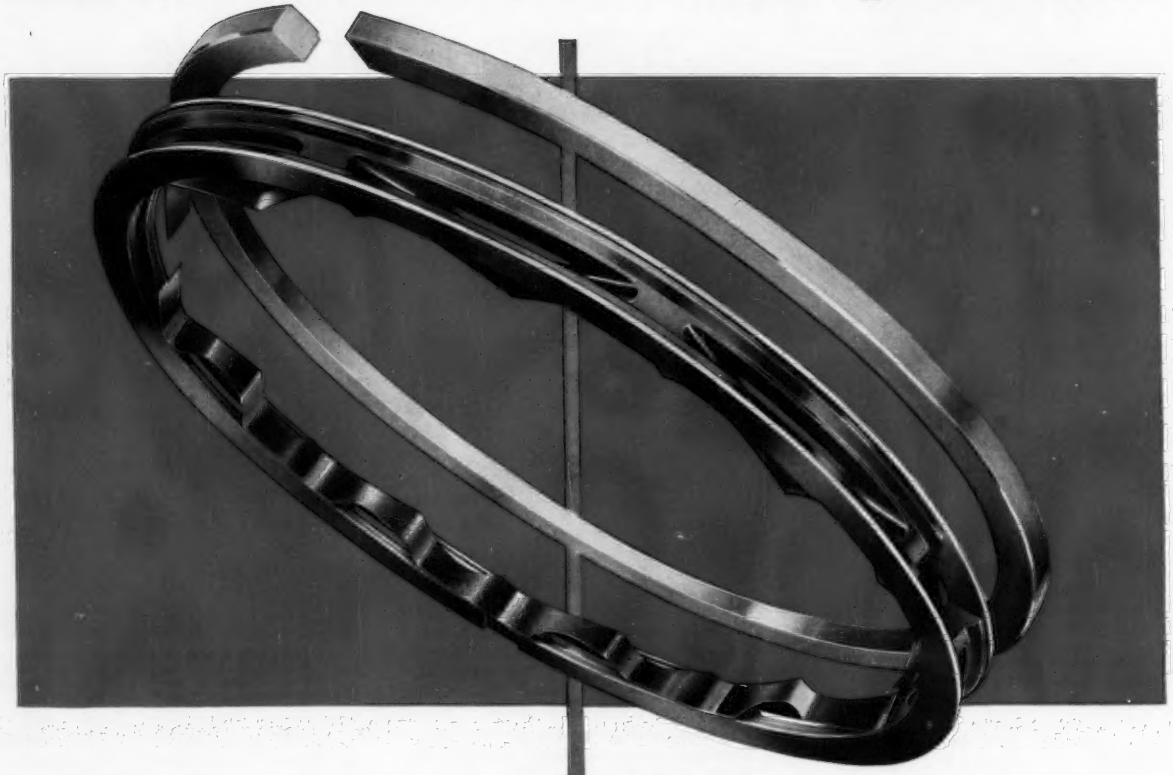
At one company's plant, a large, heavy-duty crane had deteriorated due to rivets loosening. Replacing with new rivets was no permanent answer, but RB&W high tensile bolts were.

Used with hardened washers, these RB&W bolts clamp members together so tightly, no slipping into bearing takes place, holes are reinforced against fatigue, and connections become vibration-proof.

Assembling heavy duty equipment with RB&W high strength bolts in the first place can avoid such problems and create more satisfaction with the product.

TOP PERFORMANCE LONGER LIFE

under continuous heavy loads!



PERFECT CIRCLE

2-IN-1

CHROME PISTON RINGS

In Perfect Circle's 2-in-1 Chrome Set BOTH the top rings and the oil rings are plated with thick, wear-resisting solid chrome. This *more than doubles* the life of cylinders, pistons and rings!

Perfect Circle piston rings assure top performance under continuous heavy loads and adverse conditions—reason enough why Perfect Circles are preferred by so many engine manufacturers for original equipment and for replacement service.

For complete information or for special engineering consultation, write Perfect Circle Corporation, Hagerstown, Indiana.
In Canada, address The Perfect Circle Co., Ltd., 888 Don Mills Road, Don Mills, Ontario.

Agricultural Engineering

April, 1957
Volume 38
Number 4

James Basselman, *Editor*

The 1957 Yearbook . . .

THE 1957—Fourth Edition—AGRICULTURAL ENGINEERS YEARBOOK is off the press and will be mailed within the next few weeks to all members of the American Society of Agricultural Engineers whose names are included in the active roll of members at the time of mailing. The price of the Yearbook is included in the annual membership dues paid by each ASAE member. The price to non-members of ASAE is $5.00 per copy postpaid.

The Yearbook includes a variety of information about the American Society of Agricultural Engineers as an organization and about many of its activities—all brought together under one cover for readily accessible reference. The Yearbook is proving to be a most useful tool to ASAE members for the reason that it provides much information for which they have frequent need and which otherwise would be available only from many different and sometimes uncertain sources.

Of particular value to ASAE members is the fact that the contents of the Yearbook are brought up to date once every year. Not only is the material contained in preceding editions revised and improved, but much new material is being added each time it is reissued.

The Yearbook contains all the current ASAE-Approved Standards, Recommendations, Codes and Data. Added this year are new standards on preferred drive wheel tire and rim sizes for general purpose farm tractors; safety lighting breakaway connector and cable for farm implements; minimum standards for irrigation equipment, and a sprinkler irrigation technical data sheet. Improvements have been made in ASAE Standards on power take-off for farm tractors, farm tractor auxiliary power take-off drives, and agricultural wheel-type tractor test code.

One section of the Yearbook is devoted to a directory of suppliers to agricultural engineers which contains a list of trade associations with activities related to agricultural engineering, a list of leading manufacturers of products having wide application in agriculture, and a classified list of manufactured products and the principal manufacturers of each.

A new feature this year is a list of ASAE members who are engaged in consulting engineering services. Other features of the Yearbook include the ASAE membership roster, a list of ASAE officers, divisions, sections, committees, student branches, constitution, by-laws and rules.

In planning the material to be included in succeeding editions of the Yearbook, the editors are governed mainly by what appear to be the most obvious needs of the ASAE members in general. The aim, of course, is to make Yearbook contents of greatest possible usefulness to the largest number of members. To accomplish this purpose, the editors are constantly searching for new features that can be added. Ideas and suggestions from ASAE members are invited. Proposals and recommendations for ASAE committee action, and subsequent approval as ASAE Standards, Recommendations, Codes, and Data, are encouraged.

Hitting Base Roots . . .

A FIVE-POINT program to improve high school science teaching and to increase the number of teachers has been launched by the American Society for Engineering Education.

In its report the ASEE Secondary Schools Committee, makes the following recommendations:

(a) Science teachers must be encouraged to be better teachers and to teach better science.

(b) High schools should have more help to improve teaching techniques, equipment, and curricula in science and mathematics.

(c) More and better qualified teachers must be found for high school science teaching.

(d) Good science courses must be made more attractive to more high school students.

(e) Teacher training requirements must be re-evaluated — and certification agencies should emphasize competence in subject matter as well as in education.

Deploring what it calls today's "anti-intellectual attitude," the committee declares that present-day living requires a knowledge of mathematics and science.

But, it reports that there seems to be an attitude, among pupils and some teachers in high schools, that the sciences and mathematics are difficult subjects, are unnecessary for everyday living, and can logically be by-passed.

Suggestions for improving the situation are under study. It has been suggested that in order to encourage science and mathematics teachers in high schools, the professional and social status of all high school teachers must be improved. Their extra-curricular loads should be reduced, and assistants should relieve teachers of routine.

Extension courses may help less qualified science teachers become better prepared for their assignments, and industry can help by providing summer jobs for science teachers. The committee applauds summer programs — such as those sponsored by the National Science Foundation — which bring high school science teachers back to university campuses.

But most important, says the report, those responsible for teacher certification should be encouraged to "waive the requirements *temporarily* for those *qualified* in the sciences but lacking some, or in special cases even all, of the presently required courses in teacher training." This would permit the high schools to turn to valuable new sources of science teaching talent — retired scientists and college teachers, for example. In addition, many industries may share their staff members to help teach science in high schools, a plan already successful in some communities.

It seems that ASEE has recognized an important problem relating to the perpetuation of the engineering profession and should be encouraged in its efforts.

Strain Gage Cell Measures Soi P

A. W. Cooper, G. E. Vanden Berg, H. F. McColly, A. E. Erickson
Member ASAE Assoc. Member ASAE Member ASAE

RECENTLY, interest has increased markedly in factors causing compacted layers in agricultural soils and in deep tillage. This interest has been brought about by: *(a)* increased amount and weight of traffic over fields with tractors, implements, and trucks, *(b)* results showing that for some soils, deep tillage increased water intake and produced substantial increases in crop yields, *(c)* increased power available to do deep tillage, *(d)* increased interest in deep fertilizer placement, and *(e)* indications that some tough soils are easier to plow in the spring if they are ripped with a deep tillage tool in the fall.

Soil compaction may be due to mechanical packing by tractor tires and implements, causing a pressure pan, or due to fine particles moving down to the bottom of the tilled layer, causing a filter pan. The mechanical compaction of soil due to equipment is largely a function of the total weight operating over the field and, as will be shown later, deep compaction cannot be decreased materially by increasing tire size alone.

This paper covers the development and testing of an electrical resistance strain gage pressure cell designated as Type A. It can be used to measure pressures in soil caused by tillage implements and traffic over the surface of the soil. Pressure measurements made with this type cell have been compared with those made with a large load cell and with theoretical pressures calculated by use of Froehlich's formula (1).* Results are shown of tests in a laboratory soil box and in a simulated field.

Paper prepared expressly for AGRICULTURAL ENGINEERING and based on doctoral thesis prepared by A. W. Cooper while attending Michigan State University. Authorized for publication by the U.S. Department of Agriculture and as Journal Article 1957 of the Michigan Agricultural Experiment Station.

The authors—A. W. COOPER, G. E. VANDEN BERG, H. F. McCOLLY, and A. E. ERICKSON—are respectively, agricultural engineer, (AERB, ARS) USDA; graduate research assistant in agricultural engineering; professor of agricultural engineering, and associate professor of soil science, Michigan State University.

The Type A Soil Pressure Cell

A detailed sketch of the Type A pressure cell is shown in Fig. 1. It consists of a 2-in stainless steel disk soldered to a small round brass box with a removable bottom. Two ⅛-in SR-4 electrical resistance strain gages are cemented to the lower side of the metal disk and as near the center as possible. Two "dummy" gages used for temperature compensation and to complete the bridge circuit are cemented to the inside wall of the brass box. A 4-wire shielded cable is brought out of the cell in the manner shown in Fig. 1 and is connected so that the two "active" gages are in opposite arms of the bridge. The two "dummy" gages form the other two arms of the bridge.

As a uniform pressure is applied over the surface of the stainless steel disk it acts as a diaphragm. A slight deflection of the diaphragm causes a strain in the metal which is meas-

*Numbers in parentheses refer to appended references.

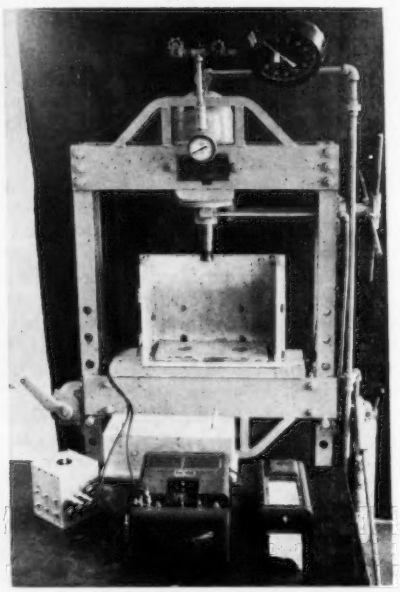


Fig. 2 *(Above)* General view of equipment for testing soil pressure cells in soil in the laboratory

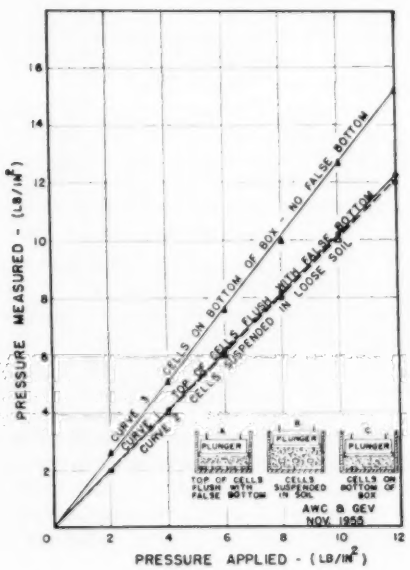


Fig. 3 *(Right)* Calibration of Type A strain gage pressure cells in Maumee sandy loam

Pressure

A specially-built pressure cell has demonstrated its ability to measure soil pressure with reasonable accuracy when suspended in a relatively homogeneous soil mass

ured by means of the strain gages, an amplifier and recorder. The calibration of this cell is linear from 0 to 40 psi.

Calibration of the pressure cells was accomplished by placing the cells in a closed system filled with water and by applying a range of pressures to the liquid and hence the cells. The applied pressures caused a strain in the cell diaphragm which was measured and recorded.

Testing Type A Cells in Soil Box

Three series of measurements were made to determine how the Type A cell would function in soil. The soil box used was 18 in long, 8⅓ in wide, and 14 in high, (Fig. 2). The plunger for applying pressure to the soil was designed to transmit a uniform load up to 100 psi. It had a face area of 142 sq in to allow clearance in the soil box which had a cross-sectional area of 144 sq in. A hydraulic press was used to apply the loads to the soil in the box (Fig. 2). The applied load was indicated by a pressure gage connected to the fluid chamber of the press. Calibration of the load-applying system was accomplished by applying a load to a platform scale. A Brush amplifier and recorder were used to measure the change in resistance of the strain gages when pressure was applied to the cells.

In the first series of tests three cells were placed in the bottom of the soil box with the tops of the cells flush with the top of a false bottom (Fig. 3A). Four inches of soil (Maumee sandy loam screened through a 2-mm sieve) were placed in the box and leveled with a template. Loads of 2 to 12 psi were applied to the surface of the soil in 2-psi increments and the resulting pressures on the cells were measured. Since the tops of the cells were flush with the top of the false bottom, the soil pressure on the cells and the false bottom was assumed to be the same. The soil was then removed and a new batch placed in the box for the next test. This procedure was repeated three times, giving nine measurements for each pressure applied. The cells were then suspended in an 8-in depth of soil with 4 in of soil above the top of the cells (Fig. 3B). As in the first series of tests, the soil was placed loosely in the box and leveled with a template. Pressures were applied in the same manner and amount as in the first series of tests and the same number of replications was made. The cells were then placed on the bottom of the box without the false bottom and soil was placed in the box in the same manner as in the first two series of tests with 4 in of soil above the tops of the cells (Fig. 3C). Pressures were applied and measured in the same manner and number as before.

The results of the tests are presented in Fig. 3. Since the tops of the cells were flush with the top of the false bottom (Fig. 3A), in the first series of tests, these pressure readings were considered as the basis for comparison. Comparing curves 1 and 2 of Fig. 3, it can be seen that there was no significant error due to suspending the cells in loose Maumee

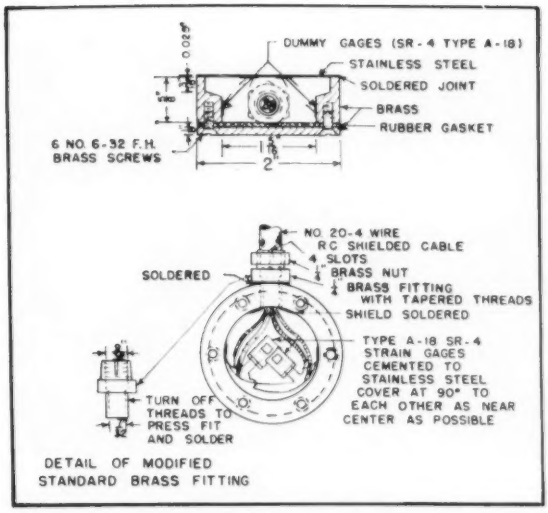

DUMMY GAGES (SR-4 TYPE A-18)
STAINLESS STEEL
SOLDERED JOINT
BRASS
RUBBER GASKET
6 NO. 6-32 F.H. BRASS SCREWS
2"
NO. 20-4 WIRE R.C. SHIELDED CABLE
4 SLOTS
SOLDERED
BRASS NUT
BRASS FITTING WITH TAPERED THREADS
SHIELD SOLDERED
TYPE A-18 SR-4 STRAIN GAGES CEMENTED TO STAINLESS STEEL COVER AT 90° TO EACH OTHER AS NEAR CENTER AS POSSIBLE
TURN OFF THREADS TO PRESS FIT AND SOLDER
DETAIL OF MODIFIED STANDARD BRASS FITTING

Fig. 1 Type A soil pressure cell

sandy loam soil. With a thicker cell, according to the Waterways Experiment Station (2) and results reported later in this paper, this error is appreciable. Curve 3, Fig. 3, shows that in loose soil with the cells on the bottom of the box, an error in pressure measurement of as much as 25 percent may be obtained. In this case the cells are not free to move with the soil as the soil is compacted. The soil to the side of the cells compacts causing a concentration of load on top of the cells, resulting in a higher pressure in the soil than would be present if the cell were not there. The 25 percent error constitutes a maximum because the bulk density of the soil in this test was a minimum. If the initial bulk

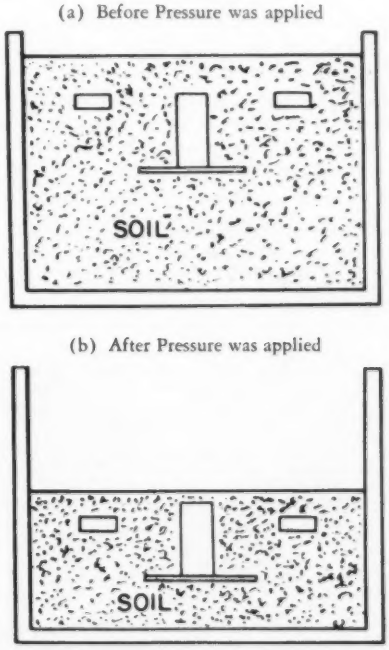


Fig. 4 Position of Type A and load cells before and after pressure was applied

Fig. 5 Method of placing cells in the soil at the plowing demonstration in Chicago

density of the soil were higher, there would be less compaction of the soil at the sides of the cells and therefore less concentration of load on the cells.

Comparison of the Type A and Soil Science Cell†

Pressures developed in soil under the same loading conditions were measured with the Type A cells and a soil science load cell in the laboratory and in a simulated field. The soil science load cell is 1¾ in in diameter and 4⅛ in high with a 6-in diameter base. It is equipped with electrical resistance strain gages to measure the strain in an enclosed cylinder. The strain is proportional to the load applied to the top of the cell. The laboratory and simulated field soils used were similar in mechanical analysis but differed in initial bulk density. The Hillsdale sandy loam used in the laboratory tests had a low initial bulk density (approx. 0.90 gm per cc) and the soil in the simulated field had a very high bulk density (approx. 1.60 gm per cc).

In the laboratory two Type A cells and a load cell were suspended in loose Hillsdale sandy loam in the soil box. The tops of the cells were placed 2 in below the surface of the soil. Pressures of 2 to 12 psi were applied to the surface of the soil in 2-psi increments. A comparison of pressures

†The load cells were designed and built by J. P. DeKoning, applied mechanics dept., Michigan State University, to be used by N. A. Willits for his research which is described in his Ph.D. thesis, Michigan State University, 1956.

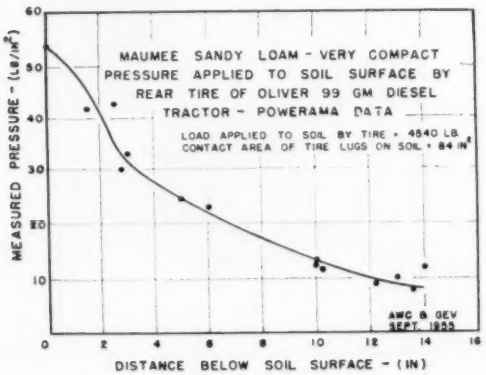

MAUMEE SANDY LOAM - VERY COMPACT
PRESSURE APPLIED TO SOIL SURFACE BY
REAR TIRE OF OLIVER 99 GM DIESEL
TRACTOR - POWERAMA DATA
LOAD APPLIED TO SOIL BY TIRE = 4840 LB.
CONTACT AREA OF TIRE LUGS ON SOIL = 84 IN²
AWG & GEV
SEPT. 1955
MEASURED PRESSURE - (LB/IN²)
DISTANCE BELOW SOIL SURFACE - (IN)

Fig. 7 *(Left)* Change in soil pressure with depth

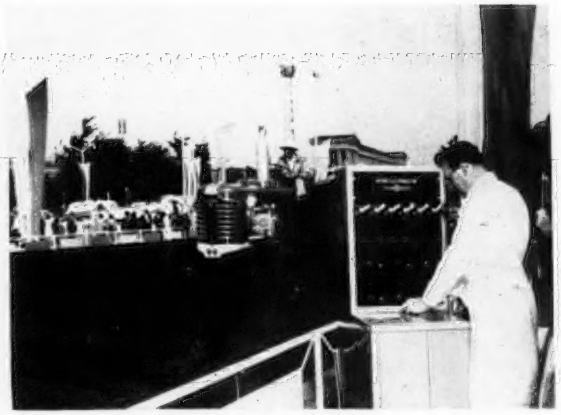


Fig. 6 The 6-channel direct inking oscillograph

measured in the soil is given in Table 1. Fig. 4 shows the relative position of the cells before and after the load was applied to the surface of the soil. These data indicate that a large error might occur in using the load cells for measuring pressures in very loose soil.

TABLE 1. COMPARISON OF TYPE A AND LOAD CELLS IN VERY LOOSE HILLSDALE SANDY LOAM

Pressure applied, psi	Pressure measured (psi) Type A Cell 1	Type A Cell 2	Type A Average Cell 1 and 2	Load Cell
2	1.8	2.3	2.0	2.2
4	3.8	3.8	3.8	13.0
6	5.8	5.7	5.8	43.3
8	7.7	7.3	7.5	95.5
10	10.0	9.5	9.8	186.6
12	11.6	10.7	11.2	243.0

Height of load cell—4.1 in
Diameter of top of load cell—1¾ in
Diameter of bottom of load cell—6 in
Height of Type A cells—0.7 in
Diameter of Type A cells—2 in
Initial depth of soil:
Above all cells—2 in
Below Type A cells 1 and 2—9.8 in
Below load cell—6.4 in
Final depth of soil:
Above Type A cell 1 and 2—1.3 in
Above load cell—0.6 in
Below Type A cell 1 and 2—5.3 in
Below load cell—2.6 in

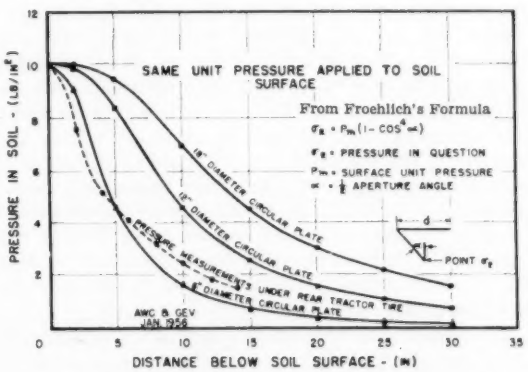

SAME UNIT PRESSURE APPLIED TO SOIL SURFACE
From Froehlich's Formula
σz = Pm(1 - COS⁴α)
σz = PRESSURE IN QUESTION
Pm = SURFACE UNIT PRESSURE
α = ½ APERTURE ANGLE
d
POINT σz
18" DIAMETER CIRCULAR PLATE
12" DIAMETER CIRCULAR PLATE
PRESSURE MEASUREMENTS UNDER REAR TRACTOR TIRE
8" DIAMETER CIRCULAR PLATE
AWG & GEV
JAN. 1956
PRESSURE IN SOIL - (LB/IN²)
DISTANCE BELOW SOIL SURFACE - (IN)

Fig. 8 *(Above)* Effect of load area on pressure in soil at various depths

Under the simulated field conditions pressures indicated under tractor and implement tires with the load cell were approximately twice as high as pressures indicated with the Type A cells. This soil with a high bulk density deformed very little as the load was applied to the surface of the soil, therefore the error in measurement of pressure with the load cell was not as great as with the loose soil.

There are two basic reasons why the load cell indicates higher pressures than would exist if the cell were not in the soil. First, the base of the cell has 26.3 sq in as compared to the area of the top of 2.4 sq in. Second, the soil around the cell deforms while the deformation of the cell is negligible. Both of these factors cause a concentration of pressure on top of the cell and result in an indicated pressure higher than that which would exist if the cell were not present.

Field Scale Testing of the Type A Pressure Cell

One part of the General Motors Powerama Show‡ held in Chicago in September, 1955, was a plowing demonstration. Fourteen train-car loads of Maumee sandy loam soil were imported from South Bend, Indiana, and placed on asphalt paving adjacent to Soldier's Field. The soil covered an area 286 ft long and 60 ft wide to a depth of approximately 15 in in the 40-ft wide plowed area. The soil was plowed aproximately 300 times. An Oliver Super 99 GM Diesel tractor pulled a 6-bottom moldboard plow (16-in bottoms). The 72-drawbar-hp tractor with plow turned an 8-ft strip each pass. The center 40 ft on the plot was plowed in about 5 minutes with 5 passes.

To make the pressure readings six Type A cells were buried at the same depth and 0.4 ft apart (Fig. 5) on centers perpendicular to the direction of travel of the tractor. During the demonstration the cells were placed at various depths in order to obtain the change in soil pressure with depth under the tire loads. The cells were placed in a horizontal position and measured the vertical components of pressure. Fig. 6 shows the instrument used to record the pressure measurements.§

The pressure measurements‖ plotted in Fig. 7 (except the 54-psi value at the soil surface) were measured with Type A pressure cells under the center of the rear tires of the tractor. The points, although scattered, give an indication of how the pressure in the soil decreases with depth under a surface load. The soil was very dense and the entire weight on the rear axle of the tractor was carried on the lugs of the rear tires since they penetrated the soil less than ¼ in. Each rear tire carried about 4,505 lb. The area of the lugs in contact with the soil was 84 sq in, thus giving an average surface pressure of 54 psi. The tire inflation pressure was 16 psi. Each point represents a different pass of the tractor over the cells. It is quite likely that the lugs were in a slightly different position with respect to the cells each pass which caused a slight scatter of the points. Also, since the average pressure applied to the surface was approximately 54 psi, the surface pressure just over the cell might have been slightly higher or lower than the average. In any event, the data do line up in reasonable magnitude so that it can be concluded that the Type A cell measures the pressure in the soil with a reasonable degree of accuracy.

A Theoretical Discussion of the Effect of Load Area on Pressure in Soil at Various Depths Below the Surface

Fig. 8 shows the pressures at various depths under the centers of three different diameter circular plates, uniformly loaded, as calculated by Froehlich's formula

$$\sigma_z = P_m\ (1 - \cos^4\alpha)$$

Where σ_z = pressure at distances under the load along the load axis, psi

P_m = surface unit pressure, psi

α = one-half the aperture angle (the aperture angle being the angle z formed by lines connecting z to the ends of a diameter of the circular plate)

From the three curves using 18, 12 and 6-in diameter plates,

(Continued on page 246)

‡General Motors Corp. staged the Powerama to celebrate the production of their 100 millionth Diesel horsepower. The plowing demonstration was conducted by the Detroit Diesel Engine Division of General Motors Corp., Detroit, Mich., and the Oliver Corp., South Bend, Ind.

§ The 6-channel dynagraph recorder was made available for the duration of this project through the courtesy of Offner Electronics, Inc., Chicago, Ill.

‖Only a small amount of the pressure data obtained is reported and discussed in this paper to show how the cells functioned. A complete analysis of the pressure data is reported by G. E. Vanden Berg of the agricultural engineering dept. in a Michigan State University M.S. thesis, 1956. The soil physical measurements will be reported by A. E. Erickson of the soil science dept., Michigan State University.

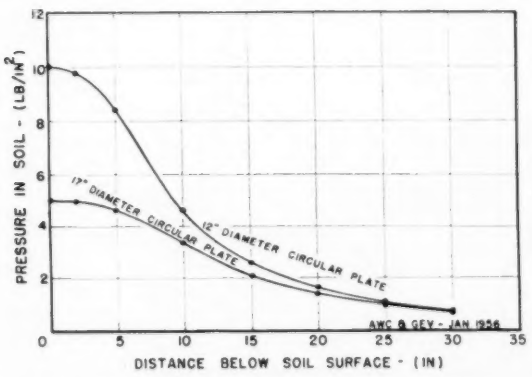

PRESSURE IN SOIL - (LB/IN²)
DISTANCE BELOW SOIL SURFACE - (IN)
18" DIAMETER CIRCULAR PLATE
12" DIAMETER CIRCULAR PLATE
AWC & GEV - JAN 1956

Fig. 9 *(Above)* Effect of doubling the surface area while keeping the load constant as calculated from Froehlich's formula

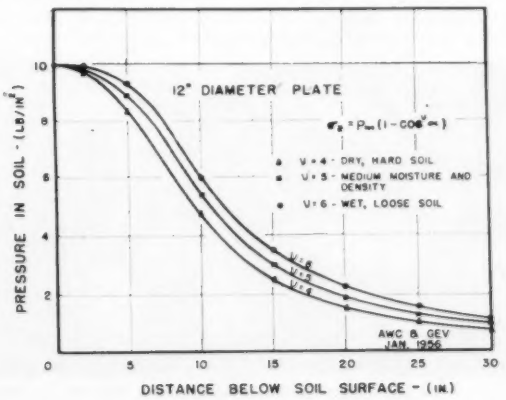

12" DIAMETER PLATE
V = 4 - DRY, HARD SOIL
V = 5 - MEDIUM MOISTURE AND DENSITY
V = 6 - WET, LOOSE SOIL
PRESSURE IN SOIL - (LB/IN²)
DISTANCE BELOW SOIL SURFACE - (IN.)
AWC & GEV JAN. 1956

Fig. 10 *(Right)* Effect of moisture and bulk density on soil pressure at various depths under a surface load

Method for Testing Milking Machine Pulsators

A research study by the author has resulted in developing a method for testing milking-machine pulsators that will prove of value to designers in connection with pulsator layouts

Max Hupfauer
Member ASAE

FOR judging the operating quality of a milking machine pulsator, the milking output may prove useful. The milking output is the kilograms of milk which can be milked per minute. In relevant literature this value is also called milking speed. This again is not the actual milking speed but an average value for a standard time. A continuous picture of the actual milking speed can be obtained by using the milking output recorder developed and used in 1932 by W. Fritz, Weihenstephan (Fig. 1). This instrument helped such men as Fritz, Eisenreich, Korkmann, W. E. Petersen and V. R. Smith in their research work on the influence of vacuum height, pulse number and vacuum-release ratio.

The Influence of the Pressure Change Period

From 1950 to 1955 extensive investigations were made, for the first time, by the author on the influence on pressure-change periods with the same vacuum, the same pulse number and the same pulsation ratio. The pressure-change period is the time necessary for the pulsator to change over from vacuum (negative pressure) to release (normal pressure), or from release to vacuum, respectively. To investigate the influence of the pressure-change period, all pulsators in question were operated with a negative pressure of 4500 mm water column and a pulse number of 46 pulses per minute. The findings of the aforementioned research work had proved these values to be favorable for good milking results. It was found that, with different pressure-change periods with more than 1,000 measurings of cows of various breeds, the milking results varied by about 20 percent maximum. This value clearly shows the importance of the influence of the pressure-change periods. Apart from the technical aspects, such as vacuum height, pulse number, construction of the teat cups, such factors as feeding, milking technique, and operating personnel were the same for the different experimental groups. Deviations in connection with lactation periods, breed, and barn temperature were reconciled by about 100 to 150 measurings per pulsator.

Paper prepared expressly for AGRICULTURAL ENGINEERING.

The author—MAX HUPFAUER—is director, Bavarian State Institute of Agricultural Engineering and Farm Mechanization.

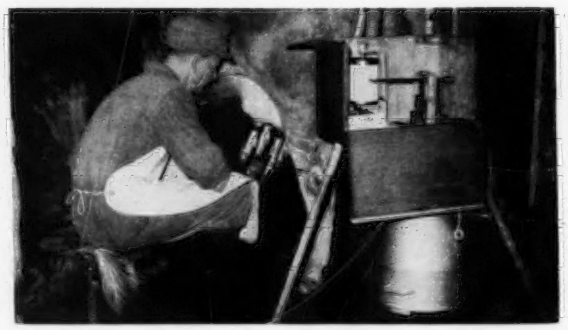


Fig. 1 This picture shows the milking output recorder in action

Influence of Milk Quantity

With regard to the influence of the milk quantity on the milking speed, average milking-speed values were found for certain milk quantities. Thus average-value curves can be drawn approximately corresponding with the ratio. Such average curves are shown in Fig. 2.

Finding the Pressure Change Periods

To test the pressure-change periods with sufficient accuracy, the pulse curves of the various pulsators were reproduced on the screen of a Philips electron-beam oscillograph (GM 3156/01). This was done by a steel membrane onto which strain gages were fixed, further by a direct-recording Philips measuring bridge (SM 5536/01) and by a Gena direct-voltage amplifier (EV 215). The curve branches of one pulse are superimposed since it was not possible to choose a lower relaxation oscillator frequency in order to

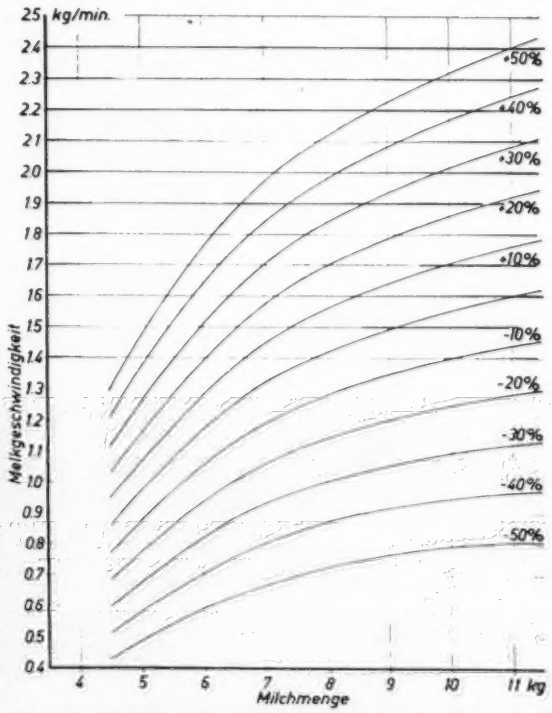


Fig. 2 Graph of correlations of milking speed and quantity of milk

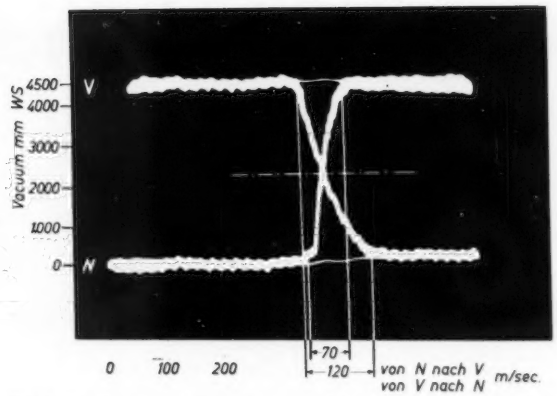


Fig. 3 Oscillogram of a pulse curve. *N* indicates normal pressure (release); *V*, vacuum, and *WS*, water column

secure a linear recording (Fig. 3). For later experiments we used a Voigtlaender-Philips Recording camera (FE 106). Here the time scale is indicated by the electrically-driven camera paper feed (Fig. 4). In both cases the pressure-change periods are found with the help of the time scale.

Relations Between Milking Curves and Pressure-Change Periods of Pulse Curves

As mentioned above, the milking-speed difference between two pulsators with different pressure-change periods was about 20 percent maximum. It was found that pulsators with a pressure-change period of about 125 ms (milliseconds) when going over from vacuum to release and of about 60 ms when changing from release to vacuum had the best milking results.

Evaluation Graph

Plotting the percentage deviation of the various pulsators in relation to the pressure-change periods, which can be read from the average-value curves of the milking speed, the result will be a diagram from which the rate of milking of each single pulsator can be immediately read after the pressure-change periods were found (Fig. 5).

Since the relation of pressure-change periods and milking speed was confirmed with sufficient accuracy by numerous experiments, this method will save us from the otherwise necessary experiments in the barn which would take months.

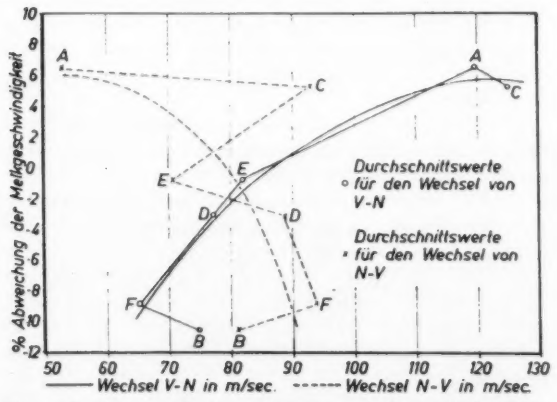


Fig. 5 Graph for evaluating pulsators in which speed changes in milliseconds are plotted against deviations in milking speed in percent. The solid-line curves represent average speed changes from vacuum to normal pressure *(V to N)*, and the broken line curves the changes from normal pressure to vacuum

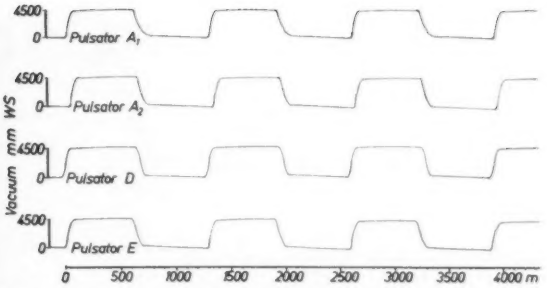


Fig. 4 Pulse curves of different pulsators as photographed by the recording camera

This technical method also confirms the results of the outstanding research work of Professor W. E. Petersen on the physiology of the milking procedure, for it shows that a soft, yet continuous and sufficiently long normal-pressure period (massaging the teat), as well as a quick change-over from normal to negative pressure, are of great advantage (Fig. 6).

The values of the pressure-change periods also provide valuable directions to the designer of milking machines for the layout of a pulsator. When time, content of the pulsator construction rooms to be emptied, and pressure difference are known, the necessary jet cross section can be found quickly and easily by electronic measuring.

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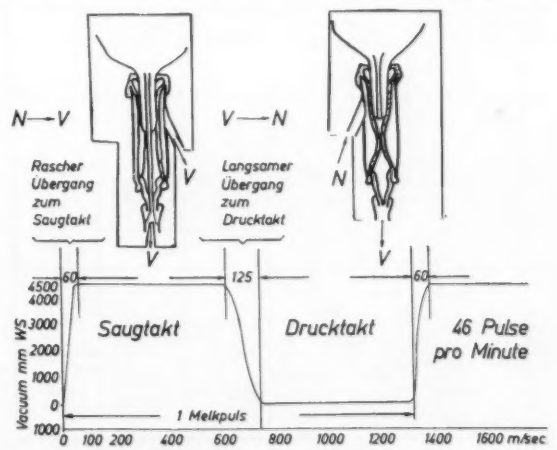


Fig. 6 *(Above)* Diagram at left indicates quick changing from normal to negative pressure, and at right from vacuum to normal pressure. *(Below)* A typical pulse curve- vacuum (Saugtakt) and release (Drucktakt)

Cooling Stored Grain

Howard K. Johnson
Member ASAE

THE cooling of stored grain in relatively large-sized storage units, such as terminal elevators, by aeration is becoming recognized as an advantageous and economically feasible practice under many conditions commonly found in the operation of various types of grain-storage facilities. Such aeration systems provide a measure of temperature and moisture control which has a definite effect in limiting both insect and microfloral activity. In addition, aeration offers a means for minimizing temperature differences within the grain mass itself, thus preventing the moisture migration which leads to chemical deterioration of stored grain. Other uses of aeration systems also have been suggested (5)* and their use for the application of fumigants has been demonstrated.

Previous papers (4, 5, 6, 10) have described the use of aeration in several types of storage structures and under various conditions, particularly in relation to the problem of moisture migration caused by wide variations between the temperature of the stored grain and the ambient temperature. The cause and prevention of moisture migration have been considered in the above references as well as in other discussions of the principles of grain storage. Although many aeration systems are used solely to prevent moisture migration, reduced storage temperatures may be equally valuable in controlling insect and mold activity.

Some of the problems connected with the design and use of aeration systems for stored grain are examined and some of the results of an investigation into these problems are offered in this paper.

Paper prepared expressly for AGRICULTURAL ENGINEERING.

The author—HOWARD K. JOHNSON—is research engineer, Cargill, Inc.

*Numbers in parentheses refer to the appended references.

Mold Growth and Insect Infestation

Moisture content, temperature and storage time define the storage potential for a given lot of grain, and, of these, moisture content has been shown to be the most important single factor in the preservation of grain quality in storage.

Since grain is a hygroscopic material, its moisture content determines the relative humidity of the interseed atmosphere. Extensive researches on the role of microorganisms in storage deterioration indicate that mold growth is the primary cause of spoilage and heating. Furthermore, it has been shown that the relative humidity of the interstitial air has a pronounced effect on mold growth and that the various species of fungi have definite limits for growth and reproduction in relation to minimum relative humidity. Experimental research on these limits and many years of practical elevator management have led to the establishment of maximum moisture levels for the storage of various grains.

The critical relative humidity for common storage molds is 70 to 75 percent; the adverse effect of air movement from warm to cool grain is immediately apparent in that cooling the air increases relative humidity and quickly creates a favorable environment for molds. If portions of a grain mass are at borderline conditions with respect to temperature, moisture content and mold infection, the convection air movement can stimulate mold activity with accompanying generation of heat and moisture. This release of heat and moisture in turn accelerates the process until a heating zone in the bin is created.

Other studies of mold activity as related to temperature and relative humidity show that reduction of storage temperature has a marked influence on the respiratory and reproductive processes of the common grain-storage molds. The prevalent species of *Aspergillus* molds in stored grain can grow to 10 to 20 times faster at 90 F than they will at 60 F (2). Fig. 1, from the data of Tuite and Christensen (12), shows how a moderate decrease in storage temperature caused a significant reduction in the percentage of germs invaded by storage molds with shelled corn at 16 percent moisture content.

The importance of uniform grain temperatures is thus made apparent. It follows that requirements for safe storage would not need to be so severe with regard to moisture content, if moisture movement within the bin could be

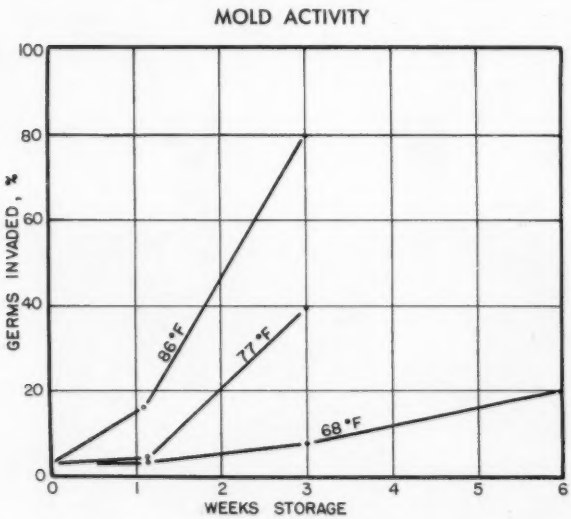


Fig. 1 Effect of temperature on mold activity in shelled corn at 16 percent moisture content

by Aeration

With aeration as a means of cooling grain stored in large-sized units gaining recognition as having many advantages, including economic feasibility, the author in this paper examines some of the problems involved and outlines the results of his investigation

avoided or minimized by uniform grain temperature. Aeration is quite effective in reducing the temperature of grain placed in storage during the summer months when grain temperatures of 85 to 100 F are common. Because grain has a low thermal conductivity and temperatures in the bulk of a grain mass change very slowly, favorable conditions for mold growth are thus maintained unless cooling is effected by aeration or by exposure of the grain to cooler air during transfer. In Minnesota, for example, where the annual mean temperature range is as much as 70 F, the swing in grain temperature would be only 1 F at a depth of 13 ft, for heat transfer limited to conduction only.

The possibility that respiration and growth of the microflora will be accelerated by the increased supply of oxygen resulting from aeration is remote unless the activity of the molds is actually inhibited by low oxygen or high carbon dioxide concentrations. In view of the tolerance of molds for oxygen and carbon dioxide levels and the normal composition of interseed atmospheres in grain bins, it appears that the inhibition of mold growth by this means is not encountered under the usual storage conditions.

Insect development also shows a strong dependence on grain temperature. Insect infestation can be controlled by fumigants but appreciable reduction in fumigant costs should be effected by the maintenance of storage conditions which retard the growth and reproduction. Rice and granary weevils are among the most common of the stored grain insects. The life cycle of the granary weevil requires 30 days at a temperature of 80 F, but a 20 F reduction in temperature to 60 F results in a life cycle of four to five months (9). The confused flour beetle shows a similar temperature dependency with an average life cycle of 27 days at 90 F, and 93 days at 72 F. This rather marked increase in time for a life cycle appears to be quite significant since it requires only a small reduction in grain temperature.

Moisture Migration

Large quantities of grain are now stored in "flat" storage, i.e., bins where the diameter or horizontal dimension is

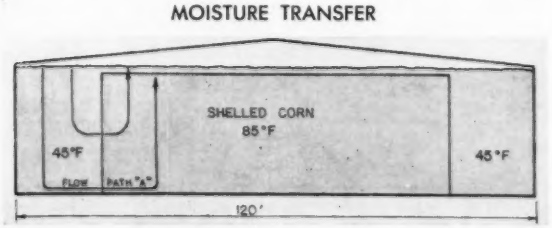
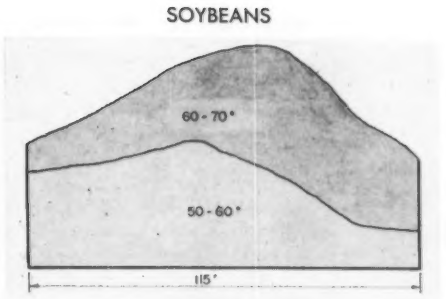
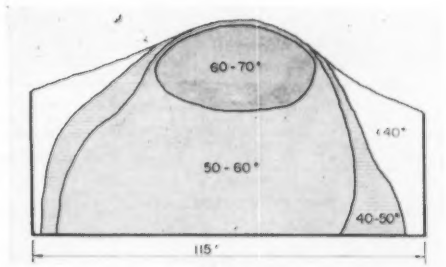


Fig. 2 Schematic diagram of cross section of grain bin for calculation of moisture transfer by air convection

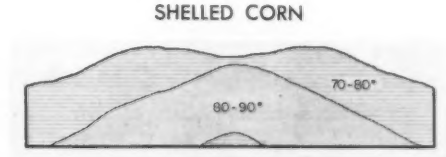


3A. November 2

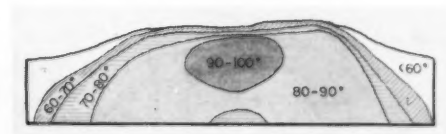


3B. January 25

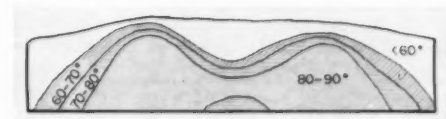
Fig. 3 Development of a grain-temperature pattern in a large bin of soybeans



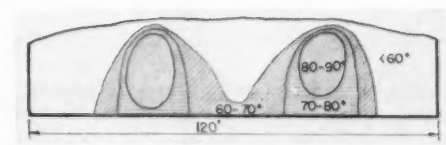
4A. September 30



4B. November 11



4C. November 18



4D. January 13

Fig. 4 Temperature distribution in a bin filled with shelled corn at four stages

greater than the grain depth, as opposed to the more conventional deep bin or silo-type structure. Construction costs per unit of volume are lower for the flat-storage units. But the problem of moisture migration is accentuated by extensive volumes of grain at different temperatures and by the difficulty or cost of turning or transferring to another bin for cooling or for equalization of grain temperature. In very large bins grain temperature differences may occur because of extended filling periods. These factors make aeration attractive for flat storage, although the initial and operating costs appear to justify aeration systems also in conventional deep storage where conveying equipment is usually provided to allow convenient transfer of grain from one bin to another at relatively low cost. The necessity of holding one bin empty may be an important item, especially where the storage units are large, resulting in an appreciable loss of income because of the reduction in effective storage space.

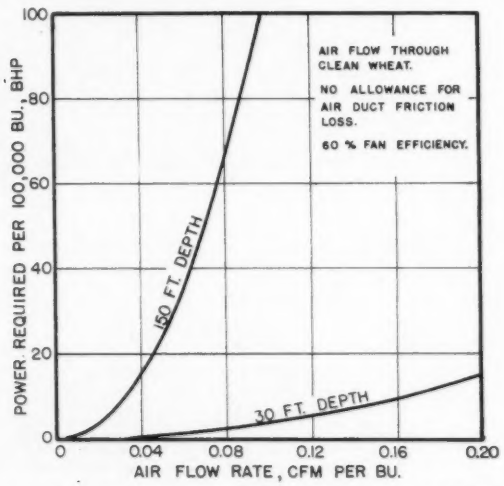


Fig. 5 Calculated power requirement for aeration of wheat at various air-flow rates

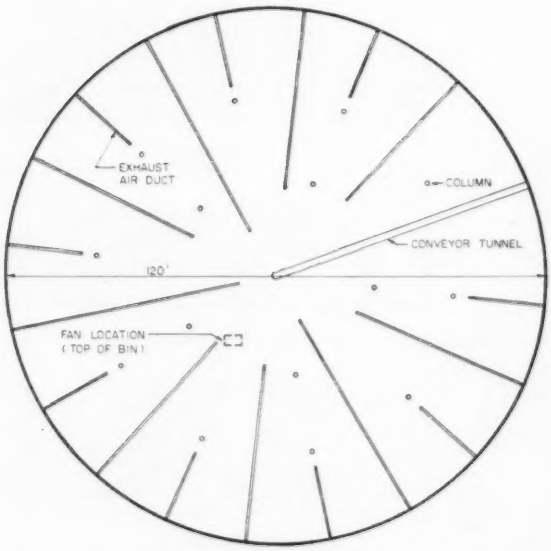


Fig. 6 Radial system of air ducts on the floor of a round bin. The aeration fan is mounted on the roof of the bin

The principles involved in moisture movement within a grain mass have been described previously (4, 5, 6, 10) and the role of temperature differences as the cause of convection air currents has been verified by observation under a variety of conditions. Shelled corn and wheat have a void space of about 40 percent of the total volume; the interstitial air assumes a specific weight which is dependent on temperature and humidity for a given atmospheric pressure. At normal grain-storage moisture contents the air relative humidity is in the range of 65 to 75 percent, and there is very little variation in specific weight over this range. However, temperature differences of 40 to 50 F are found to result in significant differences in the specific weight of air. For example, air at 85 F and 75 percent humidity has a specific weight of 0.07 lb per cu ft at standard atmospheric pressure, while air at 45 F and 75 percent relative humidity weighs 0.078 lb per cu ft, or 11 percent more.

It is of interest to calculate the amount of moisture which could be transported in a hypothetical case, assuming a sharply defined temperature distribution and a common shape for the grain mass as illustrated by Fig. 2. The bin is 120 ft in diameter and 30 ft high. The difference in specific weight of the interstitial air which results from the difference in temperature would produce a pressure of 0.017 in of water for movement of air along flow path *A*, a distance of 90 ft. An extrapolation of the data of Shedd (12) for air flow in grain indicates an air flow of 0.05 cfm per sq ft through clean shelled corn.

The amount of moisture released at the cool top surface of the warm part of the grain mass may be calculated from equilibrium relative humidity data and the psychrometric chart with the assumption that the convected air attains thermal and moisture equilibrium with 14.5 percent moisture corn at 85 F before being cooled to 45 F. In this case 21 days would be required to move enough water to increase the moisture content of a top layer six inches deep from 14.5 to 20 percent. This is recognized as a hypothetical example because of the sharp delineation between warm and cold zones and because only one flow path is considered, but it is indicative of the magnitude of moisture migration which can result from the existence of lateral temperature differences.

The potential for convection-air movement in a grain mass depends on the existence of lateral temperature differences, the magnitude of the resulting variations in specific weight of interstitial air, and the vertical extent of the zones of cool and warm grain. The air flow which results is dependent on the ease with which air may move through the grain mass as affected by the kind of grain, amount of foreign material, degree of packing, and moisture content. The relatively low air-flow resistance of shelled corn as compared to wheat is notable in this respect. If the air movement produces a moisture transfer, there must be a zone of lower temperature to increase relative humidity or condense water vapor by cooling. Condensate dripping from the cold roof surfaces of bins is one manifestation of moisture transfer.

Surface-layer moisture accumulation is often called "top sweating"; this type of moisture migration is the most common because of the temperature differences which usu-

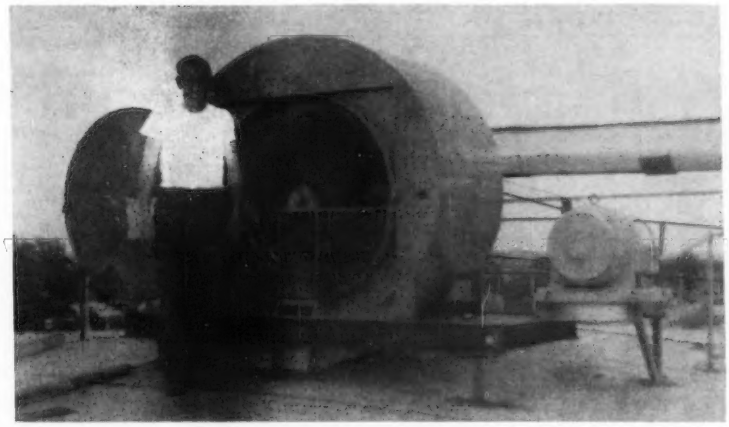


Fig. 7 Aeration fan on the top of a grain bin

ally develop in those geographical areas which have low atmospheric temperatures during the winter. However, moisture movement will be toward any part of a grain mass which has substantially lower temperature, provided the temperature distribution is favorable for initiating and sustaining convection air currents. If there is an extensive grain surface which is relatively cold as in flat storage, the air rising from warm grain will be cooled, thus increasing its relative humidity and resulting in moisture transfer from air to grain. Since this top layer may receive both heat and moisture from the convected air, conditions soon become favorable for mold growth with further heating and moisture release.

Grain-Temperature Patterns

An example of a nonuniformity in grain temperatures which developed as a result of heat loss to the atmosphere is shown by Fig. 3. A round bin, 115 ft in diameter, was filled to a maximum depth of 60 ft with 400,000 bu of soybeans at fairly uniform temperature as indicated by Fig. 3A. A change in grain temperature during the winter produced a situation favorable for moisture migration by convection air currents as shown by Fig. 3B. In this case, the relatively small area affected by top sweating was confined to the center part of the grain surface and a rather shallow layer of grain showed damage in this area.

The great heat loss indicated by Fig. 3 cannot be attributed entirely to heat transfer by conduction in view of the low thermal conductivity of grain. However, if only a small zone around the wall is cooled by heat loss through the walls, further cooling by convection may be initiated. This is a very rapid process compared to conduction and apparently the amount of cooling by this means can be sufficient to create an appreciable difference in temperature throughout a large part of the total grain bulk. This is analogous to moisture transfer by convection as opposed to transfer by diffusion; movement by convection air currents is very rapid as compared to the process of gaseous diffusion. In fact, the diffusion process is so slow that it may be ignored in the usual case of moisture migration in grain bins.

Fig. 4 shows the temperature history of a bin of shelled corn. The bin has a diameter of 120 ft and a height of 30 ft; 230,000 bu of corn were placed in the bin, beginning in the summer and extending into early fall. The initial temperature pattern is shown by Fig. 4A. Storage was in a location where winter temperatures are not extreme, but a change in grain temperatures was involved in a condition problem illustrated by Fig. 4B for November 11. A portion of the grain was drawn from the center of the bin as a preventative measure; this portion was cooled and returned to the bin and this produced the temperature pattern of Fig. 4C. Heat and moisture transfer occurred during the winter months and by January 13 there was extensive top sweating in a surface layer above the warm part of the grain mass as indicated by Fig. 4D. Moisture migration gradually decreased as atmospheric temperatures increased and as the effects of convection cooling reduced the average grain temperature.

Aeration System Design

Flat storages of the type shown by Fig. 4 may be equipped with aeration systems to provide uniform cooling of the grain, thus minimizing the effects of undesirable temperature patterns and facilitating storage at temperatures which are less favorable for mold and insect activity. The temperature to which the grain may be cooled is limited only by atmospheric conditions, or more specifically by the duration of periods favorable for cooling and the air-flow rate provided.

From the standpoint of inhibiting mold and insect activity, the lowest possible storage temperature is preferable. However, there are disadvantages in cooling to a low level in that a great difference between grain and air temperature will be encountered if storage is continued through the summer with the possibility of subsequent moisture movement. If cold grain is moved out of storage during the warmer months, a significant amount of moisture may be picked up because of grain temperature being below the atmospheric dew point. This moisture would not be sufficient to increase the average grain moisture content appreciably, but it would occur on the kernel surfaces where it could initiate activity of the everpresent molds. Such condition problems with cold grain moving out of storage during the summer months have often been observed. Although the optimum storage temperature has not been determined with regard to these factors, the range of 40 to 60 F appears desirable for aeration cooling at terminal elevators.

An aeration system consists of a fan to produce air movement and some kind of air-distribution system to effect more or less uniform flow of air through the grain mass.

(Continued on page 244)

INSTRUMENT NEWS:

Temperature Measurement by Remote Control

H. B. Puckett
Member ASAE

A REMOTELY controlled temperature measuring system was required in tobacco-curing research work. A satisfactory remote switching system* was developed for use with a potentiometer-type self-balancing temperature indicator, Fig. 1. The curing barns were from 50 to 450 ft from the control point. The switch-control unit is the phase of this system that will be discussed.

INSTRUMENT NEWS (Karl Norris, Editor) is sponsored by the ASAE Committee on Instrumentation and Controls. Contributions on agricultural applications of instruments and controls and related problems are invited, and should be submitted direct to K. H. Norris, 105A South Wing, Administration Bldg., Plant Industry Station, Beltsville, Md.

Paper prepared expressly for AGRICULTURAL ENGINEERING.

*This device was developed and used at the Tobacco Experiment Station, Oxford, N. C.

The author H. B. PUCKETT — is agricultural engineer, Farm Electrification Section, (AERB, ARS), U.S. Department of Agriculture, University of Illinois, Urbana.

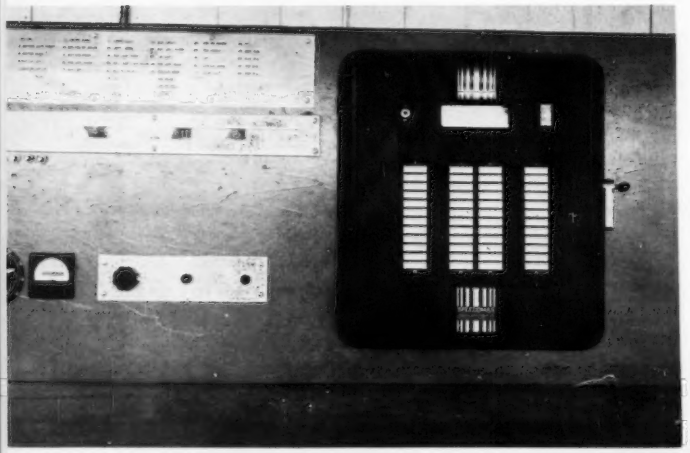


Fig. 1 Remote switch controls and electronic temperature indicator

Four stepping switches were used, one at each barn, Fig. 3. Each switch had eight banks of 20 points each. Three of the banks were used in this installation. The additional banks were provided for system expansion. Each bank on each switch was connected by a separate lead wire to the temperature indicator. The constantan leads of the thermocouples attached to the switch at each barn were joined together and one common constantan extension lead was run from each remote switch location to the temperature indicator. By selection of the proper bank and stepping switch position, any one of the thermocouples in the system could be connected to the indicator. A mercury commutator was used to connect thermocouples attached to the rotating tiers of one barn to the indicator, Fig. 2.

The switch control panel consists of an adjustable 28-volt d-c power supply, an indicator to show the rotor position of the stepping switch, and an automatic selector relay to stop the stepping switches on a preselected position. The position indicator also showed if each remote stepping switch was synchronized.

The circuit of the controller and remote stepping switch is shown in Fig. 4.

The sequence of operation for manual point selection is as follows: Depression of manual push button (1) energizes the power relay *(A)* which energizes the four remote stepping switches (Clare Type SD 24) and the stepping switch on the panel (Clare Type SD 19) which operates the position indicator and generates the pulses for automatic stepping. Releasing the manual push button (1) de-energizes all stepping relays and permits the driving springs to advance the switches one point.

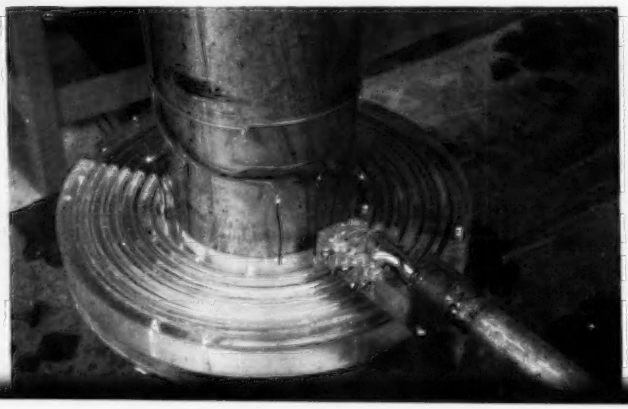


Fig. 2 Six mercury-filled commutating rings provide connection of thermocouples on a rotating member to stationary indicator. Three rings connect copper leads to banks on stepping switches, one ring connects common constantan lead to all thermocouples. The remaining two leads connect to power to operate the stepping switch

For automatic point selection, the auto-selector switch is set to the point desired, then the auto push button is depressed closing the circuit to the power relay through the interrupter springs of the SD 19 stepping switch and the normally closed relay *(B)*. The 50-mfd condenser and 100-ohm resistor on the power relay provide sufficient time delay in the opening of the power relay contacts for the more distant switches to operate and maintain synchronism. The stepping is self-sustained until the panel stepping switch (SD 19) reaches the desired point. The circuit to relay *(B)* is completed. This opens the circuit to the power relay *(A)* stopping the remote switches on the desired point.

Proper voltage adjustment of the d-c power supply is important. If it is too low the more distant remote switches will not maintain step with the position indicator. If it is too high the automatic position selector may not function, depending upon the response time of relay *(B)*.

The synchronism of the remote switches with the position indicator is checked by connecting point number 1 of one bank of each remote stepping switch in series with point number 1 of the position indicator through a signal lamp for each remote switch. If the switches are in synchronism the lamp for each switch will light each time position number 1 lamp is on. If the lamp for a switch does not light, that switch has failed to step one or more times. Each switch may be advanced by energizing it separately. This is done with an SPDT push-button switch (3). Each operation of this push button advances the remote stepping switch one step. With proper switch adjustment and operating voltage the stepping switches will maintain synchronization.

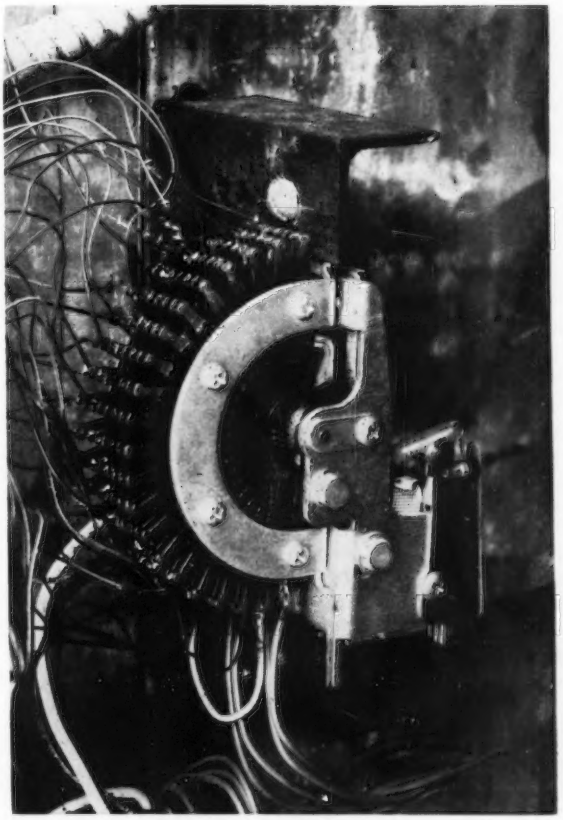


Fig. 3 Close-up view of 8-bank 20-point stepping switch installed at each remote station

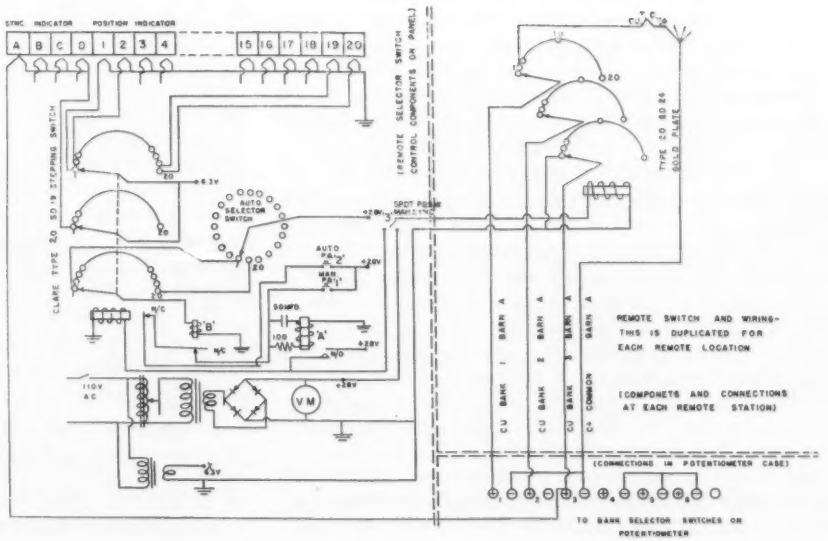

SYNC INDICATOR
POSITION INDICATOR
A B C D 1 2 3 4
15 16 17 18 19 20
CLARE TYPE 80 SD 19 STEPPING SWITCH
AUTO SELECTOR SWITCH
SPOT POSITION MAGNETRON
AUTO PAT.
MAN PAT.
50 MFD.
100
110V AC
VM
(REMOTE SELECTOR SWITCH CONTROL COMPONENTS ON PANEL)
TYPE 20 80 24 SOLID PLATE
CU BANK 1 BANK A
CU BANK 2 BANK A
CU BANK 3 BANK A
C+ COMMON BANK A
REMOTE SWITCH AND WIRING-THIS IS DUPLICATED FOR EACH REMOTE LOCATION
(COMPONETS AND CONNECTIONS AT EACH REMOTE STATION)
(CONNECTIONS IN POTENTIOMETER CASE)
TO BANK SELECTOR SWITCHES OR POTENTIOMETER

Fig. 4 The circuit of the controller and remote stepping switch

. . . Cooling Grain by Aeration

(Continued from page 241)

Either centrifugal or propellor fans are suitable when their performance is matched to the system with regard to air volume and static pressure. The data of Shedd (11) enables calculation of the static pressure for various rates of air flow which are often expressed in terms of cubic feet per minute (cfm) per bushel of grain in the storage bin. Fans may be selected on the basis of performance data as compared with the system characteristic for the desired air-flow rate. The selection of the air volume is one of the important factors in the design of an aeration system and the initial equipment and power costs depend upon the air-flow rate which is considered necessary.

The depth of the grain is the main limitation on air-flow rate because of the great increase in static pressure and power requirement with constant air volume and increasing depth. The pressure drop for flow through porous media such as grain is a function of the bulk air velocity and the length of the flow path. It is evident that increased grain depth or increase in flow rates has a pronounced effect on the power required as well as the equipment which must be provided for greater air volumes against the higher static pressures. Optimum performance of an aeration system is facilitated by the highest air flow compatible with initial equipment and power costs. For flat storage in depths of 20 to 40 ft, 0.10 cfm per bu appears feasible, while 0.03 cfm per bu has provided good results at reasonable cost for grain depths of 150 ft. Fig. 5 illustrates the calculated variation in power requirement with flow rate and depth for wheat.

A variety of materials and types of construction are currently being used in providing air distribution in grain bins. The best arrangement depends upon the geometry of the grain mass and the relative cost of various methods of providing the required uniformity of air distribution. The air ducts should be sized to avoid high friction drop and the area (perforated steel, wire screen, etc.) in contact with the grain should be adequate to allow flow of the desired air volume without excessive pressure drop due to high velocities in the grain adjacent to these surfaces. Various types of air ducts are used in storage units with large floor area; their spacing depends on the grain depth and a certain amount of judgment is necessary in determining the size, number, and spacing. References on air flow through grain are available in considering this problem (3, 7, 8, 11).

The method used in removing grain from the bin may enter into the design of an air distribution system. Fig. 6 illustrates the variation in design which may be desirable because of unique features of the storage structure. The bin is emptied by power shovels moved by cables; grain is moved toward the center of the bin. Thus it is desirable to keep the center free of obstructions and to install a radial system of ducts. The bin has a steel top which is sealed airtight to allow placement of the fan on the bin roof for air flow downward through the grain to the system of exhaust ducts which are fitted with exhaust tubes through the bin wall. This arrangement does not require the manifold which would be necessary for a suction system with downward flow of air, but does allow the use of a radial arrangement of cooling tunnels on the bin floor for minimum interference with the unloading operation at the center. Two or three feet of air space between the grain surface and the bin roof is ample for air circulation above the grain, and the spacing of air ducts on the floor has shown good uniformity of cooling.

The aeration system shown in Fig. 6 was designed to provide an air volume of 0.10 cfm per bu through wheat; the operating static pressure was 2.25 in of water for a total flow of 25,000 cfm with a power requirement of 16 hp. An arrangement of this type, where a pressure is developed under the bin top, requires consideration of the structural stability of the roof, since the upward pressure is likely to exceed the weight of the roof steel. A roof-mounted centrifugal fan is shown in Fig. 7.

Temperatures in the bin were measured by 22 permanent thermocouple cables and ten special cables placed between cooling tunnels to check on uniformity of cooling in this particular bin. The ten cables also included plastic tubing which allowed measurement of static pressures within the grain for indication of the air flow pattern.

Automatic controls were provided for starting and stopping the fan. These consisted of a high-limit and a low-limit thermostat, which controlled the temperature range for fan operation, and a humidistat for stopping the fan at atmospheric relative humidities above 80 percent. Recorders for hours of fan operation and for atmospheric temperature and relative humidity furnished weekly records of system operation and control.

Fig. 8 shows average atmospheric temperature and relative humidity, average grain temperature in the aerated bin, the hours of fan operation each day, and the average grain temperature in a similar bin without aeration. The effect of outside temperature on hours of fan operation, and the effect of relative humidity to a lesser extent, is apparent.

The cooling fan was started on August 2 when the average grain temperature was 95 F. The cooling period could have been delayed until later in the fall when outside temperatures were lower, which would have resulted in less total operating time. Operation of the cooling system during the late summer and early fall provides a relatively long and gradual cooling process extending over the months of decreasing atmospheric temperatures. Although this requires more fan operation because of the necessity of effecting several overlapping cooling processes, the difference in power cost is not of great significance if the storage potential can be increased by an immediate, moderate reduction in grain temperature. For example, the system considered here operated for a total of 686 hr in cooling from 95 F to a desired final temperature of 60 F. A part of this operating time was a result of experimentation with control equipment and was not effective in cooling because of high atmospheric temperatures. The total power cost was about 0.10 cent per bushel.

The theoretical time required for cooling may be estimated by the following simple heat-balance equation with the assumption that air is exhausted at the initial grain temperature during the entire cooling period:

$$V(w)(c_a)(60)(\Delta T)(t) = W(c_g)(\Delta T) \quad . \ . \ . \quad [1]$$

where V = aeration rate, cfm per bushel

w = specific weight of cooling air, lb per cu ft

c_a = specific heat of air, 0.24 Btu per lb per deg F

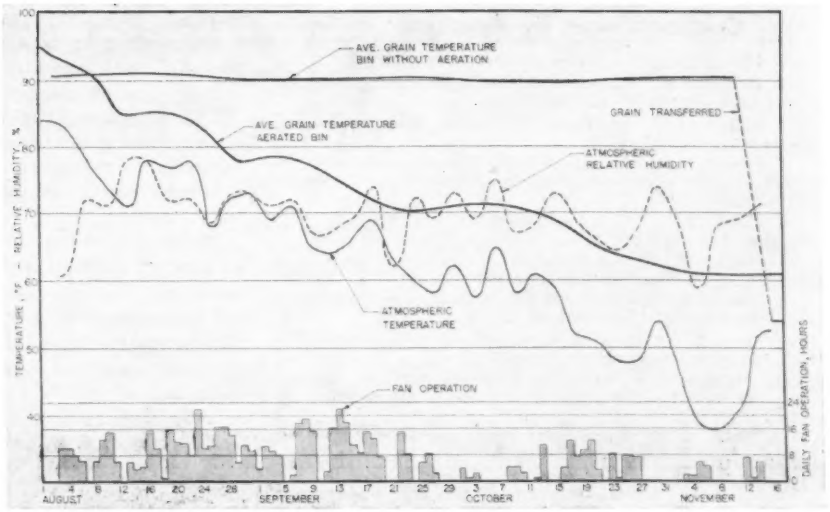


Fig. 8 Graph of performance of an aeration system in cooling 240,000 bu of wheat

ΔT = temperature difference between grain and air, F

t = time required for cooling, hr

W = weight of grain, lb per bu

c_g = specific heat of grain, approximately 0.42 Btu per lb per deg F.

The error resulting from assumption of constant exhaust air temperature depends upon the heat-transfer characteristics of the process and the air-flow rate; these factors combine to cause the equation to underestimate the time required. However, there is some conduction heat loss, and also there is appreciable latent heat exchange, since heat is required for vaporization of grain moisture. Both of these factors tend to decrease the length of the actual cooling period. Heat-balance calculations from aeration tests have indicated that latent-heat exchange amounted to 10 to 25 percent of the total sensible heat lost by the grain during the cooling process. Non-uniform air flow causes an increase in the total operating time. Variable air temperature is also involved. Consideration of all of these factors would complicate the mathematical treatment; equation [1] is useful for an approximation of the time required for cooling, but the limitations should be noted.

The automatic-control feature allows operation with little attention by elevator personnel and also facilitates cooling to a predetermined final grain temperature. For a cooling period extending over several weeks of gradually changing atmospheric temperature, the setting of a high-limit thermostat must be changed occasionally to obtain maximum cooling effect.

Some loss of moisture is usually observed during aeration as would be expected from consideration of the temperature-humidity conditions characteristic of the grain-cooling process. The reduction in grain moisture content depends on initial grain temperature and moisture content as well as outside air temperature and humidity during the cooling period. The observed moisture loss during cooling has ranged from 0.2 to 1.0 percent. Most aeration systems are designed primarily for grain cooling and the reduction in moisture should be considered as incidental to cooling.

No deterioration of grain quality was observed in the operation of the aeration system described above and other aeration tests have resulted in full maintenance of grain quality.

Conclusions

There is considerable interest in methods of employing the principle of aeration as a routine operation in grain storage and a substantial number of aeration systems are now in use under a variety of conditions in different types of storage structures. Although the full evaluation of the utility of the process will require extensive experience, it appears that the present status of aeration warrants the following conclusions:

- Grain cooling by bin aeration has been demonstrated to be effective in reducing grain temperatures with reasonable power and equipment costs.
- Mold and insect activities are sharply curtailed at reduced grain temperatures.
- Aeration cooling provides more uniform temperatures during the storage period, particularly in flat storage where conditions often produce temperature distributions which are favorable for moisture migration.
- The design and performance of aeration systems with regard to air flow, static pressure, power required, and cooling effect may be estimated from available data.
- For a given air-flow rate, power and equipment costs increase with grain depth; higher air-volume rates are feasible with lesser depth; for most installations practical levels appear to be in the range of 0.025 to 0.15 cfm per bu.
- Aeration cooling systems can be installed in many types of storage units at costs which appear to be fully commensurate with the benefits derived. Aeration may be substituted for grain transferring at some advantage with regard to costs and other factors, and bin cooling appears to be particularly advantageous in those cases where regular grain-turning operations are difficult or relatively expensive.

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. . . Strain Gage Cell

(Continued from page 235)

it can be seen that the pressure in the soil under the surface is not a function of the unit pressure alone but depends also on the total load applied to the surface of the soil.

It has been the belief of many people that if one wants to reduce compaction in the soil, all he has to do is to reduce the unit load applied to the soil and the pressure in the soil would be reduced proportionally. This belief is true for the surface pressure but is not true for the pressures lower in the soil (Fig. 9). Both curves in Fig. 9 are for circular plates carrying the same total load. The 12-in plate has exactly one-half the area of the 17-in plate, thus it applies twice the unit load to the surface of the soil. As can be seen with 10 psi applied to the surface by the 12-in plate, the pressure at 15-in would be 2.6 psi while with 5 psi applied to the surface by the 17-in plate, the pressure in the soil at 15 in would be 2.1 psi. While it helps some to double the area of contact surface of the tires of the tractor, it does not reduce to one-half the compacting pressure in the soil below plowing depth.

It is interesting to note the shape of the curve of the measured pressure under the rear tractor tire in Fig. 8. This curve is from the same data as in Fig. 7 with all the values divided by 5.4 to bring the data to the same surface pressure as the data calculated by Froehlich's formula. The shape of the contact surface of the tire was not a circle so the shape of the curves would not be expected to be identical.

Fig. 10 represents the effect of bulk density and moisture content on the distribution of pressure in soils as calculated by Froehlich's formula. As explained by Soehne (4) a v-value of 4 represents a dense dry soil, v-value of 5 represents a fairly moist relatively dense soil (about the proper condition for plowing), and a v-value of 6 represents a wet soil or relatively loose soil. Soehne (4) gives a very good discussion of the effect of the size of tires and soil condition on deformation of soil.

Summary

The Type A pressure cell reported in this paper will measure pressure with a reasonable degree of accuracy when suspended in a relatively homogeneous soil mass. A thick pressure cell gives an erroneous reading because the soil around the cell compacts and the cell does not compress, causing a concentration of pressure on the top of the cell.

According to calculations using Froehlich's formula deep soil compaction is a function of the total load applied to the surface of the soil and the area over which it is applied. It is not a function of the unit pressure applied to the soil surface alone.

Data reported show that a rear tractor tire containing an air pressure of 16 psi applied an average pressure of 54 psi to the soil. Pressures as high as 43 psi were measured in the soil at approximately 2 in depth. This soil was very dense and the entire weight on the rear axle of the tractor was carried on the lugs of the rear tires.

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(Continued from page 237)

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End of Drought in Sight?

COULD the drought be ending is asked by those who have observed the snow, sleet and rain storms that the major portion of the Southwest drought area has been having. Some slight hope is given because of the law of averages, plus some opinions expressed cautiously by students of weather cycles. It is reported that if there is anything to the theory of weather cycles, a cyclical change is about due.

Dr. Hurd C. Willett, meteorologist of the Massachusetts Institute of Technology predicts that farmers who hang on to their farms will be rewarded by crop-producing rains in a cycle of wet weather. The behavior of sun spots which come in a fairly regular rhythm is said to be an important element in his calculations. He foresees the beginning of another wet cycle "relatively soon," with the next drought period beginning somewhere around 1975 to 1980. Dr. Willett is considered one of the most experienced scientists in his field and his opinions appear in the *United States News* and *World Report.*

Adjusted "F" Factors for Sprinkler Lateral Design

M. C. Jensen and A. M. Fratini
Member ASAE Member ASAE

A TABLE of "F" factors was developed by Christiansen (1)* for adjusting data from pipe friction tables to express friction losses in sprinkler laterals. The "F" factor corresponding to the number of equally spaced sprinkler heads on the lateral is multiplied by the friction loss determined for non-branching flow. The resultant is the approximate friction loss in the lateral.

Christiansen's mathematical development assumed the first sprinkler head to be one sprinkler head spacing from the beginning of the lateral. Design now normally places the first riser one-half sprinkler head spacing from the beginning. The question arises: What influence has this arrangement on the *"F"* factor values?

Scobey's expression for friction loss, H_f, in pipes is

$$H_f = K^1 L Q^m / D^{2m+n}$$

in which K^1 = Scobey's retardation coefficient $\times$ $(4/\pi)^m$

L = length of the pipe

Q = rate of flow in the pipe

D = inside diameter of the pipe

m and n are appropriate Scobey exponents

This equation applied to the flow conditions shown in Fig. 1 results in

$$H_f = (F) K^1 L Q^m / D^{2m+n}$$

in which $F = 1/(2N-1) + [2/(2N-1)N^m]$
$[(N-1)^m + (N-2)^m + (N-3)^m \quad . \quad +1^m]$

and N = the number of sprinklers (equally spaced) on the sprinkler lateral.

Revised *"F"* factor values computed with the above formula appear in Table 1, using three values of m. An m value of 2.0 is usually used for aluminum pipe in good condition. Fig. 2 shows the adjustment to be significant.

*Numbers in parentheses refer to the appended references.

Paper prepared expressly for AGRICULTURAL ENGINEERING.

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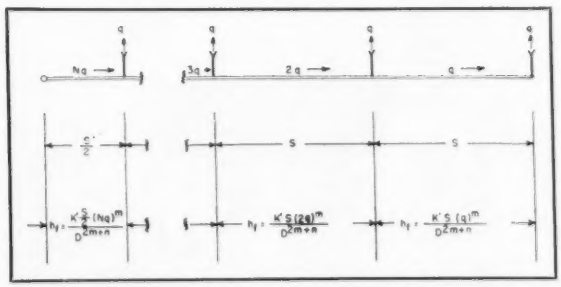

Fig. 1 Approximation of flow environment in a sprinkler lateral

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TABLE 1. ADJUSTED TABLE OF "F" FACTORS FOR SPRINKLER LATERAL DESIGN

N	*F*		
No. of sprinkler heads on lateral	for $m=1.75$	for $m=1.9$	for $m=2.0$
1	1	1	1
2	0.532	0.512	0.500
3	0.455	0.434	0.422
4	0.426	0.405	0.393
5	0.410	0.390	0.378
6	0.401	0.381	0.369
7	0.395	0.375	0.363
8	0.390	0.370	0.358
9	0.387	0.367	0.355
10	0.384	0.365	0.353
11	0.382	0.363	0.351
12	0.380	0.361	0.349
13	0.379	0.360	0.348
14	0.378	0.358	0.347
15	0.377	0.357	0.346
16	0.376	0.357	0.345
17	0.375	0.356	0.344
18	0.374	0.355	0.343
19	0.374	0.355	0.343
20	0.373	0.354	0.342
22	0.372	0.353	0.341
24	0.372	0.352	0.341
26	0.371	0.351	0.340
28	0.370	0.351	0.340
30	0.370	0.350	0.339
35	0.369	0.350	0.338
40	0.368	0.349	0.338
50	0.367	0.348	0.337
100	0.365	0.347	0.335

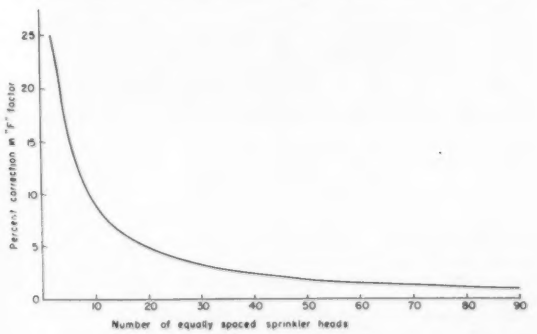
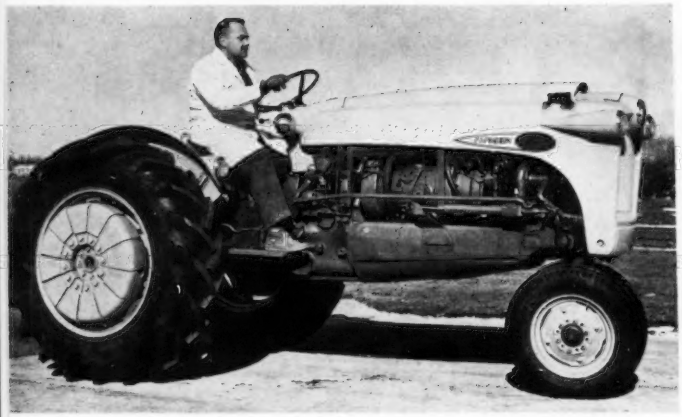


Fig. 2 Percent correction in "F" factor resulting from placing the first head ½ spacing — rather than one — from the beginning of the sprinkler lateral ($m=2.0$)

Ford Unveils New Type Tractor



THE "Typhoon," an experimental free piston-gas turbine farm tractor under development by the Tractor and Implement Division of the Ford Motor Company, was announced to the public at a special showing for press representatives at Birmingham, Michigan, March 14.

Taking a leaf from the book of automotive practice in announcing "dream cars" of the future, Ford officials mixed enthusiasm with frank admissions that much further testing and refinement work remains to be done. They were not ready to say when, if ever, they might have a tractor of this type ready for the market. Explaining their caution on this, Irving A. Duffy, group vice-president of Ford, explained that their research and development on this power plant is "aiming at a moving target." In other words, it must compete, not with the internal combustion engine as it is today, but with the continually improving internal combustion engine as it will be in the future.

Dr. A. A. Kucher, director of the Ford engineering staff, outlined 10 features of the engine which encourage their optimism, namely, (1) fuel consumption comparable to that of the diesel engine, (2) solution of the turbine blade temperature problem by using initial heat of combustion to compress air which is mixed with the gas input to the turbine, (3) basic simplicity of the free-piston gasifier unit, (4) elimination of the engine crank case and oil dilution problems, (5) variable piston stroke and compression ratio, automatically self-adjusting in operation, (6) quick starting and stopping characteristics of the free-piston gasifier, (7) freedom from high bearing loads, (8) freedom from vibration, (9) ease of assembly and accessibility for inspection and maintenance, and (10) expected long service life.

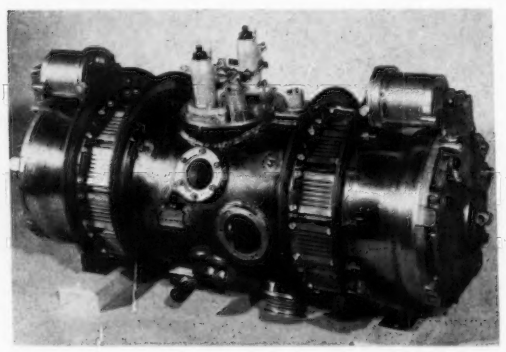
Other advantages outlined by R. J. Miller, general engineering and research manager of the Tractor and Implement Division, included a desirable torque curve, single injector and nozzle, suitability of one size of gasifier unit for a range from 30 to 100 hp, and low cost of the low temperature turbine.

Questions and discussion following formal presentation brought out further advantage of flexibility in design inherent in the fact that the gasifier and turbine are separate units connected only by a flexible pipe.

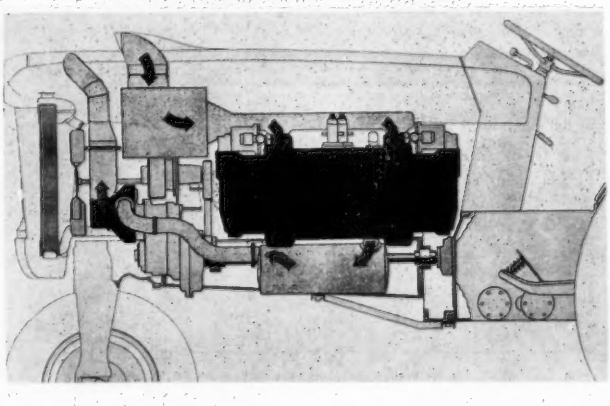
Merritt D. Hill, general manager of the Division, emphasized that the "Typhoon is far more than a laboratory curiosity. It is ready for exhaustive tests. Where these tests will lead us, no one can say at this time." He hoped that it might eventually contribute to a reduction of farming costs.

The turbine wheel is comparatively small, about 6 inches in diameter, and simple. It operates at 10,000 to 50,000 rpm. The transmission on the experimental model has 10 forward speeds and 2 in reverse. Starting is by an accumulator supply of compressed air. Exhaust noise level seemed about the same as for semi-muffled internal combustion engine tractors.

(For more facts circle No. 70 on reply card)



The gasifier, a gas generating free piston unit *(above)* that supplies hot gases to the turbine, is 32 inches in length and 16 inches in height



(Right) Schematic diagram shows air flowing through a scoop in the top of the hood (dark arrows), is filtered, and enters the compression cylinders of the engine. Hot gases produced by the engine are collected in the surge tank (shown immediately beneath the shaded gasifier) and operate the turbine (small shaded area behind the fan indicates the position of the turbine)

Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. Information concerning copies of these papers may be obtained by writing to the American Society of Agricultural Engineers, St. Joseph, Mich.

The Application of Human Engineering to Farmstead Chore Operations, by Merle L. Esmay, Agricultural Engineering Dept., Michigan State University, East Lansing. Paper presented at the Michigan Section Meeting of ASAE in Birmingham, Mich., February, 1957. Paper No. **57-21.**

This paper points out that although there has been an increase in the efficiency of performing farm tasks there has been no decrease in the time requirement of the operator because of higher production and loss of farm workers. Therefore, it indicates that there is a need for finding ways to make the tasks easy with a minimum of fatigue for the individual. Energy studies along with time and motion studies are offered as a solution.

Human engineering and energy measurements are being used in industry, by home economists in the study of homemaking tasks, by agricultural economists in the study of jobs for farm cardiac patients and by agricultural engineers in the study of the field operations of tobacco growing and farm equipment design. Preliminary work at Michigan State University has been done with portable equipment for the indirect measurement of energy expenditure based on the utilization of oxygen and production of carbon dioxide in the oxidation of body fuels to provide information for the critical analysis of building and equipment arrangement and design, as well as work methods.

What Constitutes a PhD Program in Agricultural Engineering, by E. W. Schroeder, head, agricultural engineering dept., Oklahoma A and M College. Paper presented at the annual meeting of ASAE in Roanoke, Va., June, 1956, on a program arranged by the Education and Research Division. Paper No. **57-22.**

Industries most likely to employ agricultural engineers with PhD degrees were contacted to obtain information that would be helpful in formulating objectives for training doctor's degree candidates in agricultural engineering. For information on the present status, departments granting such degrees were asked for names of those to whom degrees were granted and the employment they secured.

The paper reports that before 1950 only eight doctor's degrees were granted in agricultural engineering and some of these were not strictly engineering degrees. Since 1950, 43 PhD degrees were granted.

Sprinkler Irrigation Labor Requirements With Branched Laterals, by Herman Bouwer and J. O. Helms, respectively, associate agricultural engineer, and superintendent, agricultural engineering farm unit, Agricultural Experiment Station, Alabama Polytechnic Institute, Auburn. Paper presented at the Southeast Section Meeting of ASAE, Birmingham, Ala., February, 1957. Paper No. **57-23.**

This paper reports on labor requirements of sprinkler irrigation with branched laterals as evaluated at the Agricultural Engineering Farm Unit in 1956. Labor requirements for three different moving operations were recorded using cotton and corn as the crops to be irrigated. Sprinklers were mounted on tripods and connected to laterals with 80-ft sections of 1-in plastic hose. Sprinkler spacing was 60 x 80 ft. Starting with the sprinklers on one side of the lateral at a distance of 80 ft, the first two moves consisted of walking the sprinklers to new positions, letting the hose drag behind. For the third moving operation, aluminum pipe was hauled by trailer. It was found that branched laterals were effective in reducing total labor by one-third. Peaks in labor demands were reduced from 1.5 to 0.6 man-hours for two-thirds of the number of moves. A number of other aspects of branched laterals are also discussed in this paper.

The Cost of Farm Machinery Depreciation, by C. B. Richey, Tractor and Implement Div., Ford Motor Co., Birmingham, Mich. Paper presented at the Southeast Section Meeting of ASAE in Birmingham, Ala., February, 1957. Paper No. **57-24.**

This paper discusses depreciation in farm machinery in terms of mechanical deterioration and obsolescence. Both factors are recognized in predicting useful life and depreciation costs. Both the "double-declining balance" and "straight-line depreciation" methods for estimating depreciation are discussed.

The author also introduces a charge for crop losses due to breakdown delays which he says logically could be prorated over the life of the machine. This factor, like repairs, increases as the machine becomes older and infers an additional real depreciation during the early years of machine life. The value of a used machine is reported to be much less on a large farm at a high level of usage, on an operation where a breakdown delay is very serious, than on a small farm at a low level of usage.

Metering Devices for Bulk Milk Handling — A Progress Report, by S. A. Witzel, professor of agricultural engineering, University of Wisconsin, Madison. Paper presented at the Winter Meeting of ASAE in Chicago, Ill., December, 1956, on a program arranged by the Rural Electric Division. Paper No. **57-25.**

The author points out that there are two situations in the production of bulk milk in which metering has advantages. One is for obtaining the individual milk weights for the cows and the other, becoming less important, is when tanks are out of tolerance.

Tests on milk meters indicate that an air eliminator should be provided for their use on bulk pickup trucks unless they are to be operated under high pressures. The paper states that there will be many uses for milk meters as the dairy industry finds where they can be profitably used, and their use will be extended through the development of the air eliminator.

Tilt-up Concrete Construction, by Maurice Brandt and Irving Pflug, agricultural engineering dept., Michigan State University, East Lansing. Paper presented at the Winter Meeting of ASAE in Chicago, Ill., December, 1956, on a program arranged by the Farm Structures Division. Paper No. **57-28.**

Tilt-up concrete construction involves the casting and erection of precast concrete slabs, and is used primarily for buildings of one story in height. The paper describes units or wall panels that are precast in a horizontal position usually on a concrete floor. The panels are then tilted up into a vertical position and are joined together by pilasters which are poured in place around the ends of the panels. This system eliminates considerable handling and reduces the cost of construction.

Experimental work at the agricultural engineering department of Michigan State University has shown that a building of this type is satisfactory for use as a controlled atmosphere apple storage. Advantages claimed are resistance to wind, rain and fire, strength against lateral pressures, reduced costs and low maintenance.

Hot Water Requirements for Washing Milk Pipelines, by L. A. Brooks, electrification project leader, University of Wisconsin, Madison. Paper presented at the Winter Meeting of ASAE in Chicago, Ill., December, 1956, on a program arranged by the Rural Electric Division. Paper No. **57-26.**

This report covers comparisons of the amount of hot water used for washing pipeline milker installations on various farms and in different situations. Additional data obtained from farms over the state are used to supplement the data taken on the Electric Research Farm at the University of Wisconsin.

The paper states that based on the pipeline installations studied during the year it appears that about an 80-gallon electric water heater is the smallest that should be recommended. It is advised that a heater of sufficient capacity so that the bulk of the water can be heated at the "off-peak" rate is practical.

Engineering Education for the Creative Age, by J. D. Ryder, dean, College of Engineering, Michigan State University, East Lansing. Presented at the Winter Meeting of ASAE in Chicago, Ill., December, 1956, on a program arranged by the Education and Research Division. Paper No. **57-27.**

The author reports that the trend in engineering education has consistently been away from the empirical and toward the more scientific. This, he reports, is an indication that engineering education in future years must concern itself more with the fundamental knowledge of nature as it exists on this earth or in our universe, and because of time limitations, the educational process in the universities will be forced to give somewhat less time to applications of this knowledge.

A philosophy for engineering education is developed around a new and simplified definition for engineering, which indicates the choice facing engineering education and points to the path it should follow for the future. This definition also points out that the utilization of manpower is now a major concern of the engineer, on a par with his past utilization of materials and energy. The duty of engineering educators and of engineering employers as partners in the educational process is then made clear.

ASAE Officers for 1957-58

The following new officers of the American Society of Agricultural Engineers were elected as a result of the regular election conducted by letter ballot of its corporate members, and will take office at the close of the Society's annual meeting to be held at Michigan State University in East Lansing, June 23-26:

President — Earl D. Anderson, director of agricultural extension, Stran-Steel Corp., Detroit, Mich.

Vice-President (3-year term) — William J. Ridout, Jr., editorial director of *Electricity-on-the-Farm* magazine, New York, N. Y.

Vice-President (2-year term) — Lloyd W. Hurlbut, chairman, agricultural engineering department, University of Nebraska, Lincoln.

Councilor — George E. Henderson, coordinator of the Southern Association of Agricultural Engineering and Vocational Agriculture, and professor of agricultural engineering at the University of Georgia.

Nominating Committee — Frank B. Lanham (chairman), head, agricultural engineering department, University of Illinois; Earl T. Swink, head, agricultural engineering department, Virginia Polytechnic Institute; Mack M. Jones, chairman, agricultural engineering department, University of Missouri; Charles K. Otis, professor of agricultural engineering, University of Minnesota; and Clarence F. Kelly, associate agricultural engineer, agricultural engineering division, University of California.

The members of the Council for the Society year of 1957-58 will include the above newly-elected officers together with the following: Roy Bainer and Wayne Worthington, past-presidents; H. J. Barre, vice-president; and G. M. Eveleth and D. C. Sprague, councilors.

Members of the Society are invited to send to any member of the Nominating Committee such suggestions as they may have for nominees for election of officers of the Society in the next annual election of officers which will be held early in 1958. It is desirable that such suggestions reach the Nominating Committee on or before June 1, 1957.

FEI Meeting

A meeting of the Farm Equipment Institute, sponsored by the production and marketing dept., will be held on Friday, May 17, at the Royal York Hotel in Toronto, Canada.

During the business program discussions on the subjects of can a good farmer make money under today's prices, and on the farm equipment dealer and his problems, are scheduled to be presented, respectively by Howard G. Diesslin and R. W. Dibble. An open forum, on Canadian and U.S. agriculture and on the outlook for the farm equipment industry, is planned. For additional information write to R. A. Jones, Executive Secretary, FEI, 608 S. Dearborn St., Chicago 5, Ill.

Details for Annual Meeting Extension Exhibits

The Extension Committee is going all out to make the ASAE Golden Anniversary Meeting to be held June 23 to 26 at Michigan State University, outstanding with respect to exhibits.

There will be classes for just about any type of exhibit. These classes include publications, demonstration models, movies, radio and TV, slides and film strips, extension methods or recipes, and textbooks. Blue ribbons will be awarded winners in all classes except textbooks. Industry groups will not compete against the public agency groups and vice versa.

Publications: Included in this entry will be bulletins and periodicals and these will be separated into industrial and public agency classes. Each ASAE member may enter one bulletin and/or one periodical. Write for an application blank to Donald W. Derber, agricultural extension section, U.S. Steel Corp., 2831-525 William Penn Pl., Pittsburgh 30, Pa.

Demonstration models are to "show developments having engineering implications relating to agriculture, the primary objective of which is the education of the viewer." Classes will be provided for public agency and industrial groups. Rules and regulations for entry of demonstration models may be obtained from B. F. Cargill, extension agricultural engineer, agricultural engineering dept., Michigan State University, East Lansing.

Movie awards will be made in two classes, those prepared by industrial or commercial organizations, and those developed by colleges, universities and other public agency groups. Any group or any individual who has developed a movie during the past year is eligible to enter competition for this blue ribbon by writing B. P. Hess, Westinghouse Electric Corp., Dept. 10-L, East Pittsburgh, Pa.

Radio and TV Exhibits: Any charts, photographs, slides and other specimen used in the preparation of television and radio materials that might make interesting exhibits for ASAE can be entered by writing for an application form from Donald Brown, extension agricultural engineer, Michigan State University, East Lansing.

Slide and Film Strips are some of the most effective teaching aids in extension programs. A set of slides or film strips that shows agricultural engineering developments or how to teach some phase of agricultural engineering may be submitted. There are two classes, one for industrial and commercial groups and one for the public agency group. For applications on slides and film strips write to D. M. Byg, extension agricultural engineer, Ohio State University, Columbus.

Extension Methods and Recipes: This phase of the exhibits gives the extension agricultural engineer an opportunity to swap ideas on how best to carry out certain jobs connected with his work. Write Ralph Ricketts, extension agricultural engineer, University of Missouri, Columbia, Mo., for an application.

Textbooks are not judged or ribbons awarded but it provides an opportunity to see what is new in the textbooks field and also gives the authors and publishers an opportunity to display their publications. If any new textbooks have been produced during this year the committee would like to have them entered. Applications may be sent to J. P. Schaenzer, 1116 S. 28th St., Arlington 6, Va.

ASAE Meetings Calendar

April 11-12 — ALABAMA SECTION, Battle House Hotel, Mobile, Ala.

April 11-12 — PENNSYLVANIA SECTION, Pennsylvania State University, University Park

April 19 — WASHINGTON D. C. SECTION, Agricultural Research Center, Beltsville, Maryland

April 24 — MICHIGAN SECTION, Howell Boy Scout Camp, Brighton, Mich.

April 25 — MINNESOTA SECTION, Place not announced

April 26 — QUAD CITY SECTION, place not announced.

April 26-27 — FLORIDA SECTION, Lakeland, Fla.

April 27 — OHIO SECTION, Ohio State University, Columbus

May 3 — Organizational meeting of proposed CENTRAL IOWA SECTION, Vic's Tally-Ho Restaurant, Des Moines

June 23-26 — GOLDEN ANNIVERSARY ANNUAL MEETING, Michigan State University, East Lansing

August 27, 28 and 29 — NORTH ATLANTIC SECTION, University of Delaware, Newark

December 15-18—WINTER MEETING, Edgewater Beach Hotel, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

3rd International Congress on Irrigation and Drainage

Six days of discussions of water management problems and two weeks of field tours will draw irrigation engineers to San Francisco this spring for the third congress of the International Commission on Irrigation and Drainage.

The International Commission on Irrigation and Drainage sessions are scheduled from May 1 to 4 and will meet in the Sheraton-Palace Hotel. M. R. Lewis, ASAE member and consulting engineer, is the chairman of the California Steering Committee.

Man's opportunities to assure the permanence of irrigation agriculture is the topic of sessions on April 29 and 30 sponsored by divisions of the American Society of Agricultural Engineers, the American Society of Civil Engineers, and the Soil Science Society of America, with the ICID. Harry F. Blaney, ASAE member of the U.S. Department of Agriculture at Los Angeles, will be chairman of this inter-society meeting.

M. R. Huberty, ASAE member and chairman of the Department of Irrigation and Soils of the University of California at Los Angeles, heads the Field Trip Committee. Study tours have been scheduled for May 6 to 18.

Further information on the Congress may be obtained from the U. S. National Committee, P.O. Box 7826, Denver 15, Colo.

Agricultural Engineering Internationally

Agricultural engineering is "on the march" in an international sense. The membership in the Max-Eyth Gesellschaft has grown in the past six years from 336 to 627. In recent months, the Society of German Engineers (Verein Deutsche Ingenieur) has formed an Agricultural Engineering Division, which places agricultural engineering on a professional level comparable to that of civil, electrical and mechanical engineering.

The Max-Eyth Gesellschaft is organized for the adancement of engineering in agriculture, and its membership is open to agronomists working in this area. The membership in the VDI is restricted to graduate "Diploma Engineers", which is the equivalent to an M.S. degree in engineering in the United States. It is reported that about 50 percent of the MEG members are qualified agricultural engineers.

A program has been started, also, in which German libraries are being provided with a card index of contemporary articles published abroad dealing with agricultural engineering. A total of 37 publications published in 12 languages are regularly reviewed. To date, a total of 2700 titles have been indexed.

President Bainer On Italian Exhibition Committee

Roy Bainer, ASAE president, has been extended an honorary membership on the exhibition committee for the First International Exhibition of Tractors and Relative Equipment to be held in the Exhibition Building, Valentino Park, Turin, Italy, May 12 to 19. Concurrently with the exhibition, field trials will be held on the Mirafiori grounds of the National Mechanical Agricultural Centre and in the Stupinigi Park.

ASEE Paper Contest

The fifth annual paper contest for engineering teachers under 36 years of age has been announced by the American Society for Engineering Education. This will be a national contest to select the best papers written by members of ASEE. The awards will be presented to the winners at the annual banquet of the Society at Cornell University in June. Details may be obtained by writing to W. L. Collins, Secretary ASEE, University of Illinois, Urbana.

National Conference on Bulk Milk Handling

The agricultural engineering and dairy departments of Michigan State University in cooperation with state and federal agencies in industry are holding a National Conference on Bulk Milk Handling, May 13 and 14, on the university campus. The objective of the conference is to bring together the outstanding authorities in the United States to assemble their ideas on bulk milk handling. Processers, producers, haulers, equipment manufacturers and their representatives and others interested in bulk milk handling are expected to attend this meeting.

Additional information may be obtained by writing to National Bulk Milk Handling Conference, Continuing Education Service, Michigan State University, East Lansing.

Director and Advisors Appointed for Thor Research Center

Donald R. Burrowbridge, ASAE member, has been appointed director and an advisory committee has been selected for Thor Research Center in Marengo, Ill. The center, dedicated last fall, is a non-profit organization sponsored by the Thor Power Tool Co. and dedicated to spearhead a research-educational program designed to help the nation's farmers take greater advantage of their modern mechanization.

D. R. Burrowbridge

Mr. Burrowbridge graduated from the University of Wisconsin with a degree in agricultural engineering. For the past ten years he has served as an agricultural sales engineer with the Public Service Co. of Northern Illinois, devising and demonstrating applications of electricity on the farm. He operates and lives on a livestock farm near the center, and has a background of vocational agriculture and 4-H work.

He will supervise efforts of the center designed to increase farming efficiency and living comfort through practical applications of research into modern farm shop techniques. Mr. Burrowbridge states that the ability of farmers to take care of their machines will largely determine the future of mechanized agriculture.

An Advisory Committee of 20 agricultural leaders and educators has been appointed to work with the center. The following nine members of the committee hold membership in ASAE: Roy Bainer, president of ASAE and chairman of the agricultural engineering dept. at the University of California; J. L. Butt, secretary of ASAE; R. N. Craig, farm shop specialist at the A & M College of Texas, A. W. Farrall, head of the agricultural engineering dept. at Michigan State University; O. C. French, head of the agricultural engineering dept. at Cornell University; R. O. Gilden, agricultural extension engineer for the USDA; F. B. Lanham, head of the agricultural engineering dept., University of Illinois; C. L. Mast, Jr., publisher of *Agricultural Leaders' Digest*, and secretary of American Agricultural Editors Assn.; and V. J. Morford, professor in the agricultural engineering dept., Iowa State College.

Other members of the committee include K. C. Butler, president, The National Flying Farmers' Assn.; Maynard Coe, director, farm div., National Safety Council; L. E. Cross, executive secretary, National Vocational Agricultural Teachers' Assn.; F. N. Farrington, past-president and executive committeeman, National Assn. of County Agricultural Agents; L. R. Harrill, state 4-H club leader in N. C.; Robert Howey, past-president, National Vocational Agricultural Teachers' Assn.; C. C. Murray, dean and coordinator, college of agriculture, University of Georgia; Mark Nichols, state director of vocational education and supervisor of agricultural education in Utah; H. J. Reed, dean and director, school of agriculture, Purdue University; Skuli Rutford, director, Minnesota agricultural extension service; and Mrs. Elaine K. Weaver, associate professor, school of home economics, Ohio State University, who will represent the interests of farm women.

The new director is planning action on the suggestions and recommendations received on projects the Advisory Committee has outlined for the research center. Most urgent of these are the research grants to agricultural colleges, pilot farm youth programs for 4-H and the Future Farmers of America, and instituting the first of annual summer classes in farm mechanics for selected vocational agriculture teachers in the model farm shop at the center.

Tobacco Literature Service

North Carolina State College recently announced the establishment of a Tobacco Literature Service. This is a joint undertaking of the D. H. Hill Library and the North Carolina Agricultural Experiment Station. The Service will assemble and publish abstracts of literature on tobacco for distribution to tobacco scientists throughout the world.

Those interested in subscribing to Tobacco Abstracts may do so by writing to the Tobacco Literature Service, D. H. Hill Library, North Carolina State College, Raleigh, N. C.

Proposed Central Iowa Section

An organizational meeting of the proposed Central Iowa Section will be held at Vic's Tally-Ho Restaurant in Des Moines, Iowa, May 3. It will be a dinner meeting with an address by some prominent ASAE member and a discussion of the organization of a new Section.

A newsletter and program will be mailed to prospective members and friends of the proposed Section soon. More complete information may be obtained by writing to Francis E. Schlueter, engineering dept., John Deere Des Moines Works, Des Moines, Ia.

Student Transfer Contest List Growing

The list of Student Branches entering the Membership Transfer Contest described in the March issue of AGRICULTURAL ENGINEERING continues to grow. At this point, it appears that competition will be quite keen — and a number of graduates will save the cost of the Society's admission fee.

It is heartening to see such keen interest being developed by our agricultural engineering graduates. These men are indicating a willingness to shoulder their share of professional responsibilities; they will be our leaders, tomorrow. Society section officers and members will take note of the active Student Branches and new ASAE members in their areas and welcome them into the professional organization for agricultural engineers.

Branches that have submitted entry lists since last month include: South Dakota, Pennsylvania, Virginia, North Carolina, Illinois, Mississippi, Maine and Georgia. Entries already on hand were from Idaho, Texas, Missouri, Alabama, and Oregon.

(Continued on page 276)

James R. Adams has accepted a position with the California Packing Corp. at their Midwestern Div., in Rochelle, Ill. He was formerly on duty with the Armed Forces.

Andrew H. Schmidt has resigned his position with the U. S. Soil Conservation Service and taken employment as an agricultural engineer in rural extension work with the California Oregon Power Co. in Medford, Oregon.

Lee F. Hermsmeier has joined the staff of the Soil and Water Conservation Research Division, Agricultural Research Service, at Morris, Minn. He transferred from the Soil Conservation Service Watershed Planning Unit at Rochester, Minn. He will serve as research program engineer.

William O. Pruitt resigned from the position of assistant agricultural engineer at the Irrigation Experiment Station in Prosser, Washington. He has joined the irrigation department of the University of California at Davis as an assistant irrigation engineer.

Thomas K. Swearingen, manager of the agricultural department, The Masonite Co., was chosen second vice-president of the newly formed Chicago Area Agricultural Advertising Association.

Richard E. Fenton, formerly design engineer for the Oliver Co. in South Bend, Ind., is now selling Oliver farm equipment in Washington, C. H., Ohio.

David Palmer is completing his graduate work at Iowa State College and will join the staff as instructor in soil and water.

Joseph P. Collopy, after a number of years experience in land development and project operation and maintenance with the Bureau of Reclamation, U.S. Department of the Interior, has severed his connection with that organization to devote his time to soil treatment work being carried on by the Collopy Electro-Soil Co., Phoenix, Ariz. The company was recently formed to develop electric soil treatment processes commercially which Mr. Collopy has developed during the past six years. Besides experience in land development and project operation that has been varied and extensive, extending from the Canadian to the Mexican borders, Mr. Collopy has carried on pioneer work in connection with the application of cathodic projection to irrigation works in the United States and Canada.

Clarence C. Haas, chief engineer of the Richmond Works of International Harvester Co., Richmond, Ind., retired April 1. He has been employed with the company since 1920 and has contributed to the improvement of corn planters, fertilizer distributors and grain grills. He is considered one of the outstanding engineers in his line.

Eugene F. Schneider, formerly vice-president of the farm implement div., International Harvester Co., has been promoted to vice-president of farm equipment product planning. He will organize and head this new staff function.

George B. Nutt, past-president of ASAE and director of extension, Clemson Agricultural College, has served on an Advisory Committee for agricultural research in Sudan, Africa, as the U.S. representative. Sudan, a Republic as of January 1, 1956, formed this committee and requested his services. Britain furnished four members to the committee, Egypt two, India and the U.S. one each. Mr. Nutt reports that the committee was well balanced from a technical standpoint and he was the representative on agricultural engineering. The committee will meet annually in Khartoum. The 2½-week trip, beginning February 6, included brief stops at London, Rome, Athens, Geneva, Dusseldorf and Copenhagen.

James R. Adams is now associated with the Del Monte California Packing Corp. in their Midwest division as a student fieldman at their Mendota Farms in Mendota, Ill. Formerly he was on duty with the armed forces.

Christian L. Martin left his position with the Green Giant Co. in LeSueur, Minn., to accept employment as research and new product manager with the Farmhand Co. in Hopkins, Minn.

Wayne D. Criddle, formerly professor of civil and irrigation engineering at the Utah State Agricultural College, and irrigation engineer for ARS, USDA, has been assigned as state engineer at the Capitol Building in Salt Lake City, Utah. He will have general administrative supervision of the waters of the state and of the measurement, appropriation, proportionment and distribution thereof.

S. E. Dowling joined the extension service in the state of Florida as an agricultural engineering specialist. He is a graduate of the University of Florida. Formerly he was owner of the Dowling Equipment Co. at High Springs, Fla.

W. A. Jones resigned as extension agricultural engineer in South Carolina to accept a position with the Portland Cement Association.

F. M. POTGIETER

Fred M. Potgieter, vice-president of Mechanics Universal Joint Division of Borg-Warner in Rockford, Ill., since 1946, announces the opening of a consulting engineers office in Rockford.

Mr. Potgieter received a B.S. degree in engineering from the University of Iowa in 1922, and an L.L.B. degree from the Kent College of Law in Chicago in 1928. Special studies during the year at schools and laboratories throughout the country have added to his knowledge of the mechanics of universal joints and their performance under test. He is author of many technical articles and is frequently called upon to speak before engineering classes and foremen's groups.

He has formerly worked as hydraulic engineer for Utilities, Power and Light Corp. in Chicago; has served as vice-president and chief engineer of Universal Gear Corp. in Indianapolis, Ind., and has been employed by Morse Chain Division of Borg-Warner Corp., Ithaca, N. Y.

Since joining Mechanics Universal Joint he has been responsible for changing the company's manufacturing from automotive only, to include aircraft, agriculture, and varied industries.

B. F. Muirheid resigned his position with the University of Illinois to accept a two year assignment with the International Corporation Administration in India. He has also been an extension agricultural engineer in soil and water work in Illinois.

NECROLOGY

Marion T. Gowder, an ASAE Member since 1938, died January 5. He was born and raised on a farm near Hackleburg, Ala. He received a B.S. degree in agricultural engineering from Alabama Polytechnic Institute and also did some graduate work there.

M. T. GOWDER

He worked for the Federal Land Bank and was a county agent in Alabama for a short period. In 1934 he moved to Tennessee with the Tennessee Valley Authority as an agricultural engineer and became an extension agricultural engineer with the University of Tennessee Agricultural Extension Service in 1936. He served in this capacity until his death.

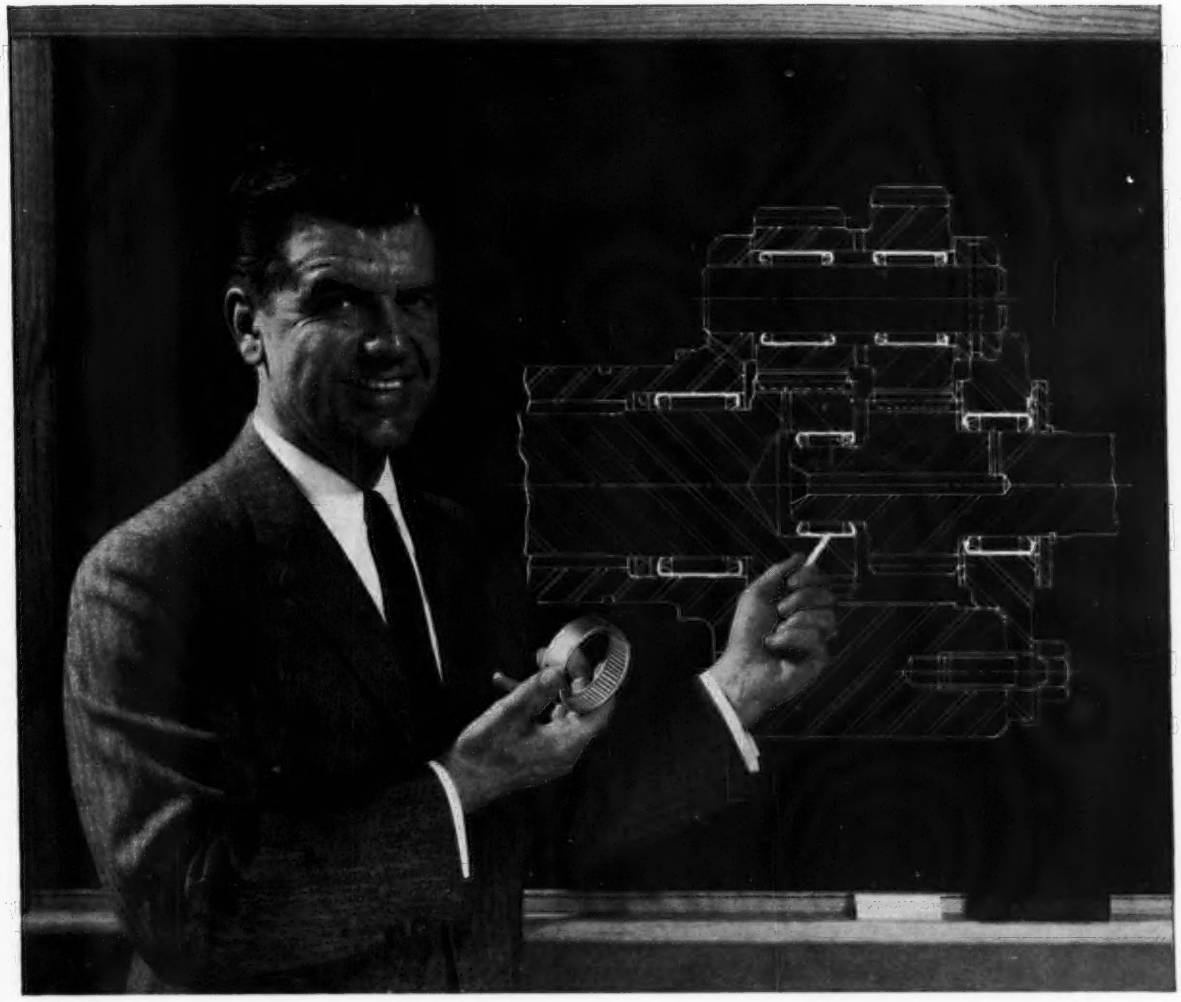
"Tim" worked primarily in the soil and water control and farm machinery fields but was also responsible for many programs in cotton ginning, farm buildings, and rural electrification. He was an active member of ASAE and served on several sub-committees of the Society. He was an active participant in the Southeast Section of ASAE, and a leader in the Tennessee Section, having held all elective offices.

Mr. Gowder was the author of several publications of the University of Tennessee Agricultural Extension Service. He organized the Tennessee Farm Contractors Association to improve the soil and water control work in Tennessee.

Walter H. Lloyd, general manager of Livestock Conservation, Inc., Chicago, Ill., died December 18 from a heart attack. He was a native of Chicago and graduated from Purdue University in 1918 with a B.S. degree in agricultural engineering.

Prior to being appointed general manager of the Livestock Conservation organization he served for 10 years as farm service director for Kraft Foods Co. in Chicago. He was editor of The Ohio Farmer from 1920 to 1942 and served with the War Food Administration in Washington, D. C., during World War II.

He was a past-president of the American Agricultural Editors Association and had served as secretary for nine years. He has been a member of ASAE since 1927, and also held membership in the Agricultural Relations Council and American Association of College Editors. He formerly served on the Farm Safety Committee, National Safety Council.



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For more facts circle No. 26 on reply card

Reports from Local Sections

Items used in this column must be received by the 20th of the month preceding publication date

Pacific Coast Section

The meeting of the Pacific Coast Section was held December 27-28 at the University of California in Davis. Osgood Murdock presided during the morning session and Austin Armer at the afternoon session of December 27. Ralph R. Parks presided Friday morning, December 28.

The technical program on Thursday, December 27, consisted of the presentation of papers on engineering and mechanical features of the Wagner 4-wheel drive tractor, by Elmer Wagner; rainfall intensity variations in northern California, by Ray K. Linsley; problems in the manufacture of special farm machinery, by E. F. Blackwelder; forced air fruit cooling, by Rene Guillou; design criteria for a driver safety frame, by Lloyd H. Lamouria; and on an analytical model of light transfer in chicken eggs, by Phillip F. O'Brien and James A. Howard.

A business meeting followed with reports of committees and the election of officers. The following officers were elected for the coming year: chairman, Austin A. Armer, Spreckels Sugar Co.; vice-chairman, Lloyd H. Lamouria, University of California, Davis; secretary-treasurer, Walter W. Weir, University of California, Berkeley; and elected member of the executive committee, Samuel V. Gunnison. The speaker for the evening program was W. H. Nutting, Pacific Gas and Electric Co., who talked on progress toward commercial nuclear power. Also a brief talk was given by Roy Bainer, president of ASAE.

The papers presented at the Friday, December 28, forenoon program were on construction and testing of continuous laid-in-place concrete pipe by Henry Shipley; a new criterion for sizing fruits and vegetables, by Robert K. Houston; influence of wind and spacing on water distribution from sprinklers, by Verne H. Scott and Jack A. Corry; and on theory and practice of fluidization applied to agricultural dusting machines, by Norman Akesson.

Virginia Section

Paul W. Stoneburner, newly elected chairman of the Virginia Section has resigned as he has accepted a position with the Reynolds Metal Co. in Louisville, Ky. and will no longer be a resident of Virginia.

George B. Duke has been chosen to fill the vacancy. The other officers elected for the coming year are: vice-chairmen, J. Nick Jones, Jr., Cecil D. Wheary, Clinton W. Shanks; secretary-treasurer, A. J. Lambert.

Southeast Section

The Southeast Section held its annual meeting February 4 to 6, at the Dinkler-Tutwiler Hotel, Birmingham, Ala. A total of 151 persons registered. Each division of ASAE held at least one session and one or more joint sessions during the meeting. Some timely papers dealing with all phases of agricultural engineering were presented at the well attended sessions. Two general sessions were held and consisted of papers on the opportunities and training of tomorrow's agricultural engineers, improving communications, teamwork, experimental design for agricultural engineering research, and the potential use of atomic energy.

During the business session the following officers were elected for the coming year: chairman, R. P. Kay; first vice-chairman, T. E. Corley; second vice-chairman, J. C. Oglesbee, Jr.; and secretary-treasurer, J. M. Myers. Resolutions were adopted concerning the passing of M. T. Gowder and the forthcoming retirement of C. A. Bennett.

The banquet on Tuesday evening was highlighted by an address by guest speaker, dr. James L. Brakefield, Liberty National Life Insurance Co., Birmingham, Ala., and a report from ASAE headquarters by secretary, J. L. Butt.

Quad City Section

A dinner meeting of the Quad City Section was held March 8 at the American Legion Building in Moline, Ill.

J. A. Weber, professor of agricultural engineering at the University of Illinois presented a paper on the topic "Can We Improve Tractor Maintenance?" A study of the facts presented in the paper indicated that tractor maintenance can be improved by placing more emphasis on design and providing more thorough and realistic information for the operator. W. G. Schmidt, Gisholt Machine Co., Madison, Wis., showed a film on the nature of balancing. It described the theory and methods of balancing rotating parts on a production basis.

The section also met January 18 at the American Legion Building.

The program consisted of papers on accelerated testing of farm tractors and components thereof by R. N. Coleman, International Harvester Co.; and on fundamentals of patent law by C. T. Parker, Deere & Co.

This division has also completed a series of four technical meetings held January 4, 11, 25 and February 1, in the Iowa-Illinois Gas & Electric Auditorium, Rock Island, Ill. The topics were on important phases of product development. C. L. Peterson, Deere & Co., and Merritt Faust, John Deere Planter Works, presented papers on cost of product development; R. R. Raney, New Idea Farm Equip. Co., talked on function; Tom Evans, Minneapolis-Moline Co., presented the topic on utility and maintenance; and safety was discussed by Robert L. Barrett, Public Service Director and Attorney for Deere & Co. The subject of appearance was presented by H. Wood Miller of the H. Wood Miller Co. and sales appeal by Les Jones, IH dealer in Iowa.

Ohio Section

The Ohio Section of ASAE will meet on April 27 at the Ohio Agricultural Experiment Station in Wooster, Ohio. The theme will be on modern research in agricultural engineering. Roy Bainer, president of ASAE, will be the keynote speaker.

The program will highlight advances in research pertaining to agricultural engineering, and will include tours of Experiment Station facilities. A flower show has been arranged for the ladies while the men are attending the afternoon technical session.

Papers on fertilization and planting practices, and promise and problems of pelletizing forages, will be presented during the technical session. A business meeting will close the session. *(Continued on page 268)*

(Above) G. W. Giles, past-chairman of the Southeast Section, presents the gavel to new section chairman, R. P. Kay, in a brief ceremony during meeting February, 4 to 6. Participants included *(Left to right)* Tom E. Corley, first vice-chairman; J. M. Myers, secretary; R. P. Kay; E. C. Easter; G. W. Giles; M. V. Stephens; Walter Baker, and Marlyn Hester

(Left) Principals in attendance at the Southeast Section meeting included four past-presidents of ASAE. *(Left to right)* R. P. Kay, chairman; M. L. Nichols, 46-47; Ivar. D. Wood, 52-53; J. L. Brakefield, banquet speaker; J. L. Butt, ASAE secretary; R. H. Driftmier, 44-45; E. W. Lehmann, 23; and G. W. Giles, past-chairman

Five "extra" reasons why farm machine designers

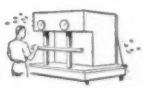
specify LINK-BELT augers

"PUSH-BUTTON" CATTLE FEEDING — from silo to trough — is one example of how Link-Belt augers help mechanize farm operations. Here Link-Belt augers on Clay Equipment Corp. (Cedar Falls, Ia.), cattle feeders eliminate time-consuming, back-breaking manual labor . . . assure uniform feeding . . . can be arranged to suit any layout requirement.

FROM selection of materials through final packing for shipment — special controls over the manufacture of Link-Belt augers provide the long-lived performance so vital to efficient operation of your machine. That's why leading designers of farm equipment rely on these Link-Belt engineering and manufacturing extras to protect the good name of their products.

1 STEELS MEET RIGID SPECIFICATIONS

Only selected steels are used—assuring a uniform, smooth, accurately rolled product.



2 CONTROLLED UNIFORMITY OF PITCH

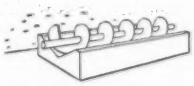
Specialized, modern machinery assures accurate forming to produce uniform flighting consistently.

3 ONE-PIECE, CONTINUOUS FLIGHTING

One-piece HELICOID flighting has greater smoothness and strength. Link-Belt also builds many different types to meet your special needs—cut flight, short pitch, ribbon flight, double flight and many other designs.

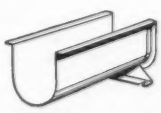
4 STRAIGHTNESS

Straightness of completed auger is carefully checked before shipping assemblies. Extra care is taken in handling and loading.

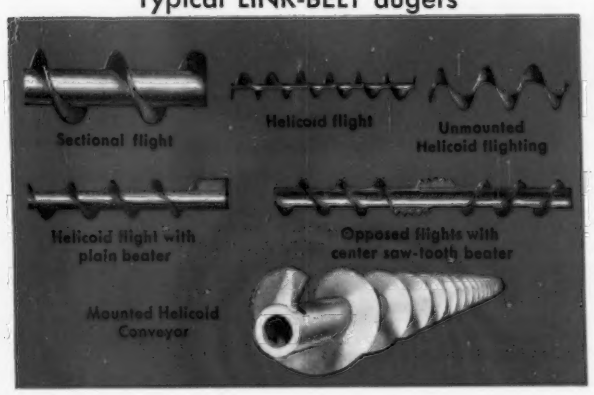


5 FULL LINE OF COMPONENTS

Every component can be supplied by Link-Belt, specially engineered for your requirements. This includes troughs, spouts, hangers, screws and drives.



Typical LINK-BELT augers



FOR COMPLETE INFORMATION on these and many other extras you get with Link-Belt augers, contact your nearby Link-Belt office. Or write for 92-page Book 2289 containing full selection data.

LINK-BELT

FARM MACHINERY AUGERS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,510

New 4-Plow Tractor

The Oliver Corp. has announced a new model of its 4-plow Super 88 tractor with a choice of three engines: gasoline, diesel and

LP-gas. Three-color combinations of green, yellow and red set the new models apart from previous models. Power steering and power-adjusted rear wheels are optionals. Four tractor styles and a new 3-point hitch attachment that accommodates standard 3-point hitch implements are available.

(For more facts circle No. 63 on reply card)

New Mounted Transplanter

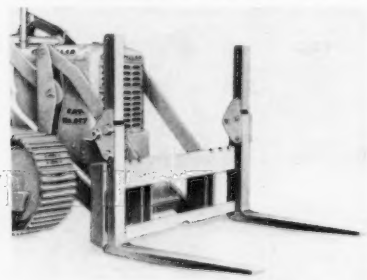
New Idea Farm Equipment Co., Coldwater, Ohio, has introduced a new mounted transplanter designed to fit more than a dozen tractor models. The new transplanter permits the tractor operator to get close to

fences and allows short turns. It follows the contour of the ground and maintains even furrow depth and uniform sets. The new model handles all transplantable crops, including tobacco, vegetable and tree seedling setting.

(For more facts circle No. 62 on reply card)

Log and Lumber Forks

Caterpillar Tractor Co., Peoria, Ill., has designed log and lumber forks as attachments for No. 977 Traxcavators. The attachment can be used also for handling poles, pipe, palletized loads and other similar material. The fork includes a carriage which is attached to the lift and tilt arms in



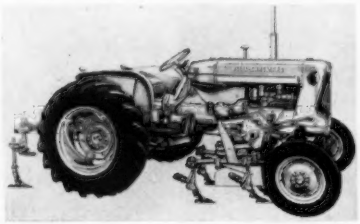
place of the bucket. The two tines are mounted on this carriage, and can be adjusted to 45, 60, 75 and 87½-in centers.

Adjustable standards, located at the top of the tines, can be set in either a vertical or 35 deg forward position to provide better load-handling characteristics.

(For more facts circle No. 67 on reply card)

New Profile Tractor

Allis-Chalmers Mfg. Co., has introduced a new low-line, high-crop clearance 3-plow tractor weighing approximately 4,100 lb.



This new Model D-14 is designed to give a low-profile unit, easy to get on and off, but without any sacrifice of high clearance.

A complete line of implements is also available for the new model — most rear-mounted implements interchange with models WD and WD-45 tractors. On-the-go shifting to high or low range, providing 8 forward speeds; a constant-speed, live power take-off regardless of ground travel speed; and a continuous operating hydraulic pump are features of the new model. Forward travel speeds can be reduced by 30 percent or increased by 50 percent when needed or desired.

(For more facts circle No. 64 on reply card)

Reverse-Reduction Unit for Gasoline Engines

J. B. Foote Foundry Co., Fredericktown, Ohio, has announced a reverse-reduction unit that offers power control for gasoline engines. It incorporates a 2:1 reduction, definite neutral, positive forward and re-

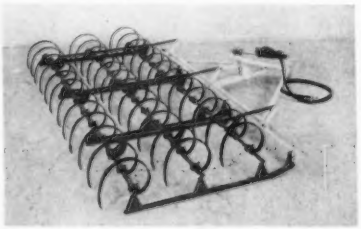
verse. The unit is enclosed in an oil-tight housing which is bolted to the engine crankcase.

The company states that a feature of the unit is the double-acting, precision machine tool clutch with over-center shift mechanism which permits the operator to shift instantly from forward to reverse or to neutral at any engine speed. Forward rotation is through a duplex roller chain drive and reverse rotation is accomplished through spur gears.

(For more facts circle No. 66 on reply card)

Hydraulically Controlled Spring Tooth Harrow

International Harvester Co., Chicago, Ill., has introduced its new No. 400 trailing spring tooth harrow. The new model is available in 8, 10, and 12-ft sizes with a choice of two tooth-spacings that work the ground, one every 4 inches and the other every 6. Tooth-clamps are secured by cup-point set screws for addition, removal, or re-positioning of teeth. Runners and front



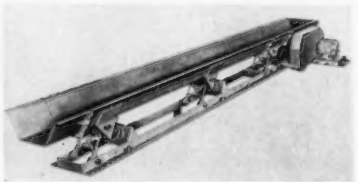
shoes are replaceable and the drawbar that extends fully across the front of the harrow may be set at three different heights to assure level operation under a variety of speed and trash conditions.

The harrow is regularly equipped for use with any standard, double-acting remote hydraulic cylinder and is available with lever controls for manual operation or a rope-controlled power-set device.

(For more facts circle No. 65 on reply card)

Oscillating Conveyors

Link-Belt Co. has announced a new design in oscillating conveyors referred to as Coilmount. The conveyor trough in which material is conveyed is supported by cast aluminum rocker legs and coil springs. In operation, motion is imparted to material carried in the trough by means of a constant-stroke eccentric drive that produces an upward and forward oscillating movement resulting in a gentle, continuous forwarding of materials. Units are available from stock



in fully assembled sections of 5 to 10-ft lengths, in trough widths of 10 and 20-in, and in 10-gauge or 3/16-in trough thickness. Sections can be assembled in lengths up to 100-ft.

Coil springs are said to absorb nearly all inertia forces, and provide maximum drive reserve for overcoming surge loads. Divider plates can be installed in the trough to convey more than one material simultaneously, and discharge of materials is possible at any desired point.

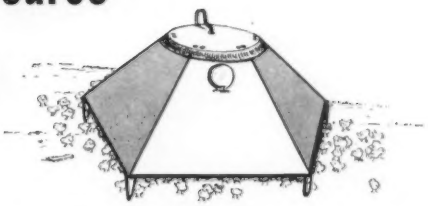
(For more facts circle No. 61 on reply card)

Hay Moisture Tester

Clay Equipment Corp., Cedar Falls, Iowa, has developed a new moisture testing kit for hay. The kit includes a small scale, a drying container for the hay sample and a fitting which can be attached to the tractor exhaust. It is entirely portable, and can be used in the field while the haying operation is in progress. The fitting for the exhaust is adjustable and will work on all tractors. It is said to be accurate to within 1 percent when properly used.

(For more facts circle No. 68 on reply card)

Why Armco ALUMINIZED STEEL Assures Top Efficiency in Heat Reflectors



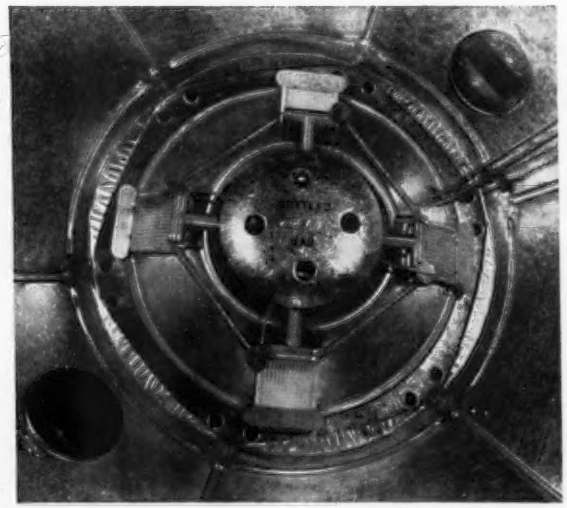
When you design equipment that utilizes heat, a superior reflector means increased efficiency. It also means that you can design for *even distribution* of heat.

These are just a few of the reasons why the largest manufacturer of poultry brooders changed from aluminum painted steel to Armco ALUMINIZED STEEL® for reflector plates above the gas burners. Up to 900 F, this special hot-dip aluminum coated steel reflects approximately 80 per cent of radiant heat.

TOP CORROSION RESISTANCE

Along with its outstanding reflective properties, Armco ALUMINIZED STEEL offers excellent resistance to atmospheric corrosion. Tests show that its aluminum coating outlasts a standard zinc coating on commercial galvanized sheets at least three to one. Thus, when brooders and similar equipment are not in use, iron oxides don't collect on the reflectors to impair their efficiency.

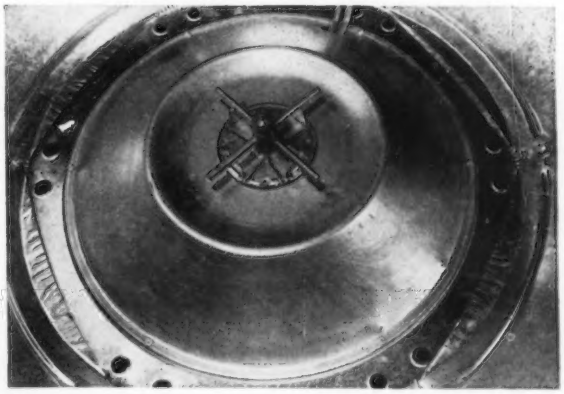
STRENGTH OF STEEL



Armco ALUMINIZED STEEL reflector plate supports heater assembly.

Because ALUMINIZED STEEL combines its heat reflective and corrosion-resisting advantages with the strength of steel, the brooder's reflector plate serves as a structural part, too. It rigidly supports the entire heater assembly. Flash tubes, gas lines, and other parts stay in alignment.

EASILY FORMED BY SPINNING



Coating on Armco ALUMINIZED STEEL withstands severe spinning operation.

Reflector plates are easily formed by spinning. The aluminum coating remains intact. Tests show that the coating retains its excellent characteristics after spinning.

WRITE US FOR INFORMATION

For complete information on Armco ALUMINIZED STEEL, just fill in and mail the coupon. Our engineers will gladly work with you on design problems.

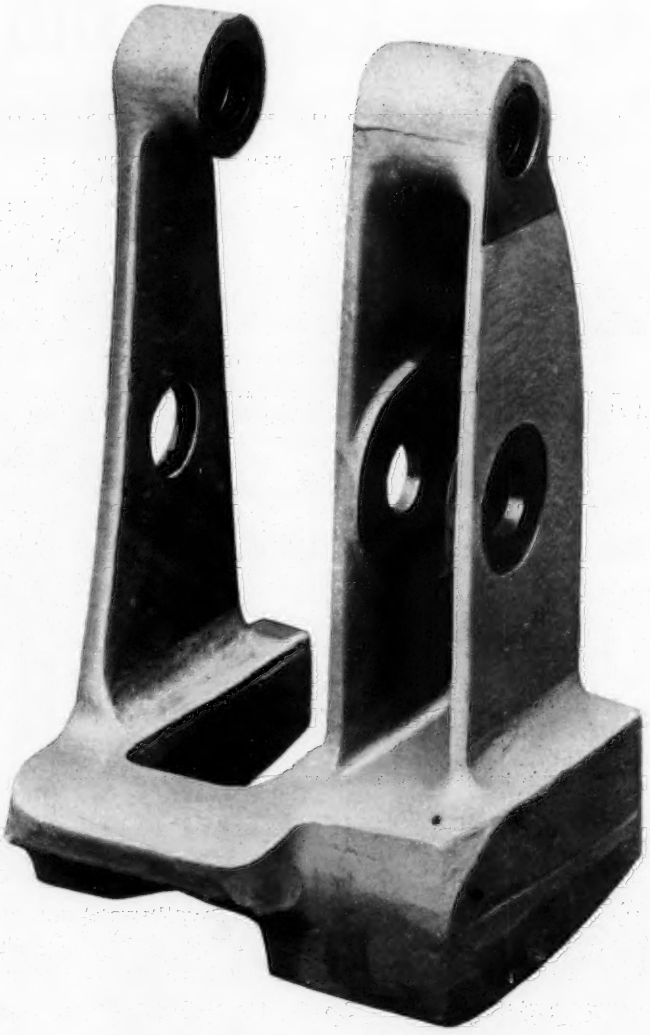
ARMCO STEEL CORPORATION
1237 Curtis Street, Middletown, Ohio
Send me information on Armco ALUMINIZED STEEL
We manufacture_____
Name_____
Company_____
Street_____
City_____ Zone_____ State_____

ARMCO STEEL CORPORATION

1237 Curtis Street, Middletown, Ohio

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

ARMCO®



New counterweight smothers vibration . . .

Heat-treatable ductile cast iron gives its thin sections high strength

In the new Ferguson "Dyna-Balance" Mower Drive*, the special properties of Ductile Cast Iron solve a difficult design problem.

Instead of the conventional pitman, Ferguson uses a Ductile Iron counterweight to balance the drive's double throw crankshaft and eliminate vibration.

High strength in thin sections with 60-45-10 Ductile

In this application, it is the heat-treatable Ductile Iron (60-45-10) that provides strength and toughness. The bosses are flame-hardened to give top wear resistance. The good castability of Ductile Iron makes possible engineering high strength in thin sections.

As Ferguson puts it:

"The use of Ductile Iron in this counterweight was the result of a need for high strength and moderately thin wall sections in a material suitable for heat-treatment. Ductile Iron could be cast in thin sections and provided sufficient strength. Ductile Iron counterweights, with flame-hardened bosses, have proved very satisfactory."

No other cast ferrous product offers such a useful combination of excellent castability and fluidity . . . high strength . . . wear resistance and machinability.

These may be just the properties you need to solve your design problem.

You'll find many practical ways to take advantage of Ductile Iron in the new Inco booklet: "DUCTILE IRON, The Cast Iron THAT CAN BE BENT." A copy is yours for the asking. Just write.

* * *

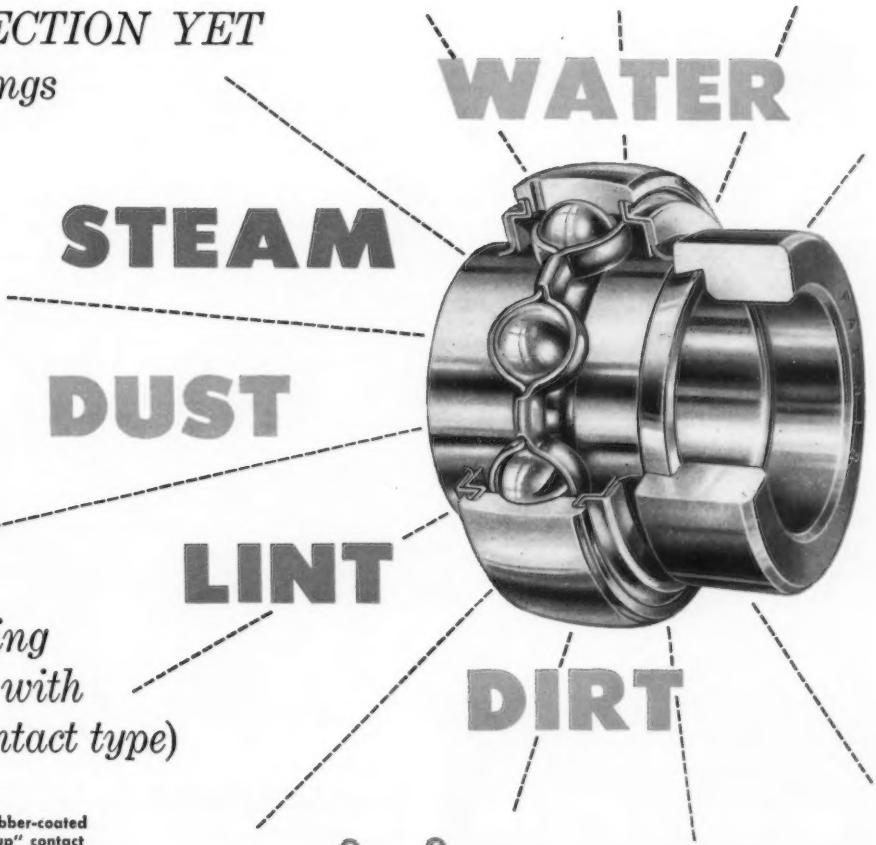
*Mower Drive built by Ferguson Division, Massey-Harris-Ferguson, Inc., Racine, Wisconsin

DUCTILE IRON

ductile iron . . . the cast iron that can be twisted and bent

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street, New York 5, N. Y.

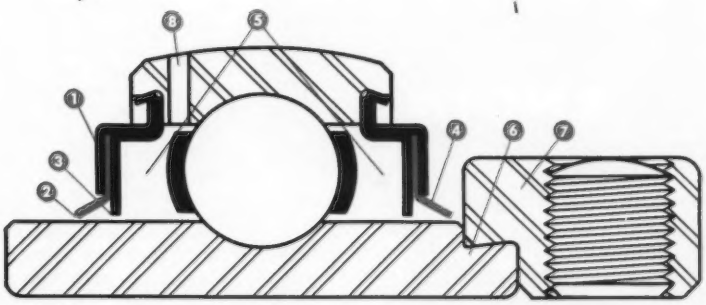
BEST PROTECTION YET
for Ball Bearings
exposed to



FAFNIR
Wide Inner Ring
Ball Bearings with
Plya-Seals (contact type)

FEATURES

1. Plya-Seal of resilient Buna N rubber-coated fabric insuring proper "follow-up" contact
2. Seal rides in firm contact on ground outside diameter of inner ring
3. Close-clearance of inside metal shield with outside diameter of inner ring provides rigid support for seal
4. Flared lip of Plya-Seal won't push in
5. Generous space for lubricant
6. Wide inner ring for extra shaft support
7. Fafnir-originated self-locking, eccentric-cam-design collar
8. Relubricatable

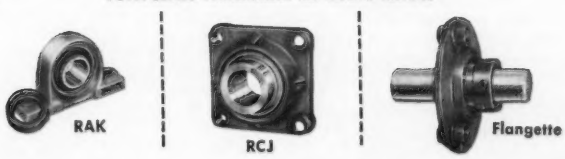


On slow to moderate speed applications where service conditions are subject to excessive contamination, Fafnir Plya-Seal equipped Wide Inner Ring Ball Bearings fill a definite need. Their laboratory and field-tested performance offers the proven protection of contact-type Plya-Seals. They provide every advantage of Fafnir Wide Inner Ring Ball Bearings with Self-Locking Collars . . . ease of application, positive locking, extra large support area on the shaft, relubricatable or nonrelubricatable, self-alignments.

The Plya-Seal as incorporated in the Fafnir Wide Inner Ring Bearing consists of two steel plates between which is sandwiched a synthetic rubber-coated fabric sealing washer. Both steel plates are fixed securely in an outer ring groove. The inner plate provides a rigid backing for the seal and a close-clearance baffle for the retention of grease.

This recent addition to the Fafnir Line is dimensionally interchangeable with the Fafnir Wide Inner Ring Ball Bearings equipped with Mechani-Seals. All types are prelubricated at the factory. Write for descriptive bulletin. The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR WIDE INNER RING BALL BEARING WITH PLYA-SEALS AVAILABLE IN UNITS BELOW



FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

MANUFACTURERS' LITERATURE

Ball Bearings Catalog

New Departure, Division General Motors Corp. — This loose-leaf binder contains six sections that deal with various ball bearing applications. Four other sections will be available in the near future. Also technical revisions and new designs which will be incorporated in the sections will be available from time to time.

The sections included at the present time are: heavy duty disc; light duty disc; idlers; cam follower; hay rake; and type AE adapter. The catalog is prepared specifically for farm implement manufacturers.

(For more facts circle No. 50 on reply card)

Farm Power Analysis

Caterpillar Tractor Co.—This illustrated 8-page brochure of farming made more profitable through farm power analysis notes problem areas that may be eliminated by proper application of farm power. It points out that problem spots on a farm may be small individually, but added together these difficult acreages cost the farmer time and money.

(For more facts circle No. 52 on reply card)

Exterior Sidings

Masonite Corporation—A 4-page brochure that describes the company's ridgeline precut exterior siding. According to the manufacturer, ridgeline cuts and fits easily without special tools, takes stain or paint well, and "out-weathers the weather."

(For more facts circle No. 53 on reply card)

Pump Data Sheet

Barnes Mfg. Co. — Catalog data sheet No. 340 contains a pump selector chart which aids farmers, gardeners, growers and livestock producers in choosing the model best suited to their particular needs. This information sheet gives heads, capacities, hp ratings, and other specifications on pumps used in a variety of irrigation and other agricultural jobs.

(For more facts circle No. 54 on reply card)

Asphalt Liners

W. R. Meadows, Inc.—The 30-page Hydromat asphalt liners manual contains illustrations and information on asphalt linings for canals, raw water storage, potable water storage, flood protection, dam facings, dike and revetment facings, spillways, chutes, farm ponds, hillside gutterings, grain storage, silo-silage storage, general farm uses, flume re-lining, etc. A section of conversion tables of general engineering data is also included.

(For more facts circle No. 55 on reply card)

Solar Poultry Houses

Libbey-Owens-Ford Glass Co. — This 8-page brochure covers the results of a survey of poultry houses in which the solar principle of heating was utilized. The use of wintertime sun heat for moisture removal in animal shelters has been studied by this company in cooperation with a number of state agricultural colleges, power company farm advisors and other farm leaders.

(For more facts circle No. 56 on reply card)

Three-Plow Tractor

Allis-Chalmers Mfg. Co. — This 51-page pocket-size booklet describes the company's new D-14 three-plow tractor. The booklet has photographs showing highlights of the D-14, its engine, and a line of mounted implements. Specifications are also included as well as photos of some of the extra equipment available for this unit.

(For more facts circle No. 57 on reply card)

Piston Ring Sets

Ramsey Corp.—This edition of the company's catalog contains a simplified listing arrangement of their engineered 10-up piston ring sets. The catalog has been compacted into 96 pages for quick usage by installers and specifiers of piston rings for cars, trucks, tractors, buses, stationary engines, and light weight 2 and 4-cycle engines.

(For more facts circle No. 58 on reply card)

Agricultural Steels

Crucible Steel Co. of America—This 20-page bulletin covers a short article on the place of tillage in soil improvement by Ernest G. Moore, and an outline of the development and use of agricultural steels as manufactured by this company. It also includes a chart on the theoretical weight of concave disks, and a radius versus concavity table.

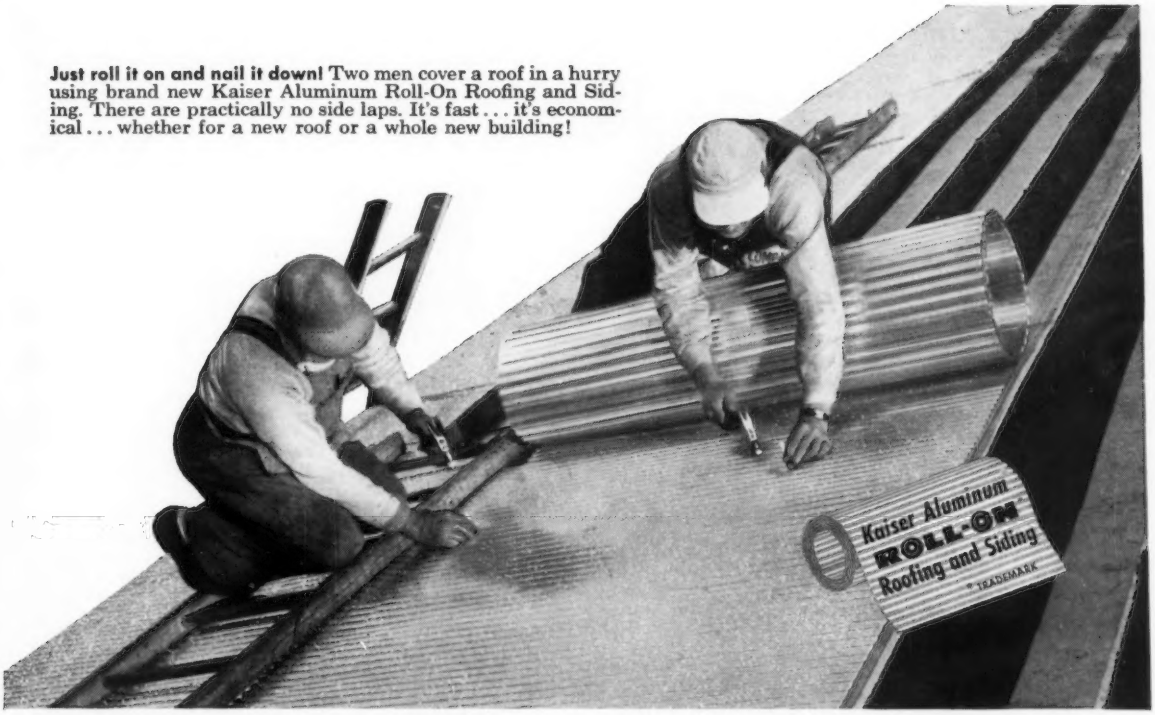
(For more facts circle No. 59 on reply card)

Polymide Tubing

The Polymer Corp.—This 4-page Bulletin BR-3A, describes some characteristics and installation advantages of the flexible polyamide tubing along with available sizes and information on where to best use the tubing. Also included are pictures and operating instructions for installation tools. The bulletin reports that this pressure tubing can be used with standard metallic flare or flareless fittings.

(For more facts circle No. 60 on reply card)

here's "HEAVYWEIGHT"
POWER PERFORMANCE
Introducing
the NEW
56 H.P.
Model VR4D
in a light weight, man-size
WISCONSIN
Air-Cooled
ENGINE
• Climaxing years of engineering development, this great new engine offers manufacturers and users of power equipment all the advantages of AIR-COOLING, at temperatures from low sub-zero to 140° F., in an exceptionally rugged engine that measures up to any "heavy weight" industrial type liquid-cooled engine, horsepower for horsepower, with many *plus values.*
The outstanding High Torque characteristic of the Model VR4D engine, combined with its extremely rugged construction and heavy-duty stamina, provide *load-lugging holding power,* long life and top power performance.
Advanced "V" design provides an extremely compact power package which includes all traditional Wisconsin heavy-duty features such as tapered roller main bearings plus additional new features.
•
Model VR4D Open Engine with heavy-duty clutch, rotating screen, electrical equipment and pre-cleaner.
This new engine rounds out a complete line, comprising 15 models in 4-cycle single cylinder, 2- and 4-cylinder sizes, from 3 to 56 hp. Write for "Spec" Bulletin S-207.
MOST H.P. HOURS
WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46, WISCONSIN



Just roll it on and nail it down! Two men cover a roof in a hurry using brand new Kaiser Aluminum Roll-On Roofing and Siding. There are practically no side laps. It's fast . . . it's economical . . . whether for a new roof or a whole new building!

NOW! SHOW FARMERS THIS TESTED WAY TO BETTER FARM BUILDINGS . . .

Brand new Kaiser Aluminum Roll-On* Roofing and Siding

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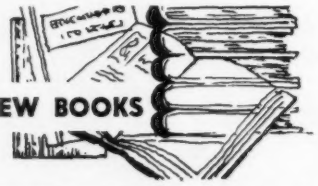

The Agricultural Commodity Programs — Two Decades of Experience, by Murray R. Benedict and Oscar C. Stine. Cloth, 6 x 9, xliii + 510 pages, indexed. Published by The Twentieth Century Fund, 330 West 42nd St., New York 36, N. Y.

This volume examines specific commodity programs for tobacco, cotton, wheat, rye, rice, fruits and vegetables, coarse grains and livestock, wools, oilseed crops, butter, cheese, poultry and eggs, milk, potatoes and sugar. The problems and policies of production and marketing are outlined, with emphasis on price supports, supplemental payments, acreage allotments and land conservation measures, tariffs and import quotas, effects of drought, war and depression, efforts to stimulate consumption and other important facets of the programs.

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CLUTCHES

An Encyclopaedia of the Iron & Steel Industry, by A. K. Osborne. Cloth, 6×9 inches, xv+558 pages. Illustrated and indexed. Published by the Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. $25.00.

The purpose of this encyclopaedia is to provide a description of the materials, plant, tools and processes used in the iron and steel industry, and in those industries closely allied to it, from the preparation of the ore, down to the finished product; and to define the technical terms employed.

The book is a reference, not a textbook, and the specialist will find it helpful for information on subjects bordering his own. The book should be of great value to the smaller firms in the iron and steel and engineering industries, which do not have libraries of their own.

The five appendices in the book include information on conversion tables, weights and measures, properties, signs and symbols and a list of scientific, technical and trade societies and other groups related to the iron and steel industries.

Timber Design and Construction Handbook, by Timber Engineering Co., an affiliate of the National Lumber Manufacturers Association. Cloth, 6 x 9 inches, 631 pages, illustrated and indexed. Published by F. W. Dodge Corp., 119 West 40th St., New York 18, N. Y. $12.75.

This book was written by 25 engineers and specialists, and edited and reviewed by a special nine-member editorial committee. It serves two purposes: It is a comprehensive timber design reference, and is also a practical field handbook. It offers essential information needed to develop and construct for quality and economy in wood structures.

The handbook has three main sections. The first section covers the fundamental structures and characteristics of wood, its types, grades, and ways of preservation. The second section explores and analyzes preliminary considerations, general design procedure, design details, fabrication and erection. The third section provides design and engineering specifications and tabular data in simplified form.

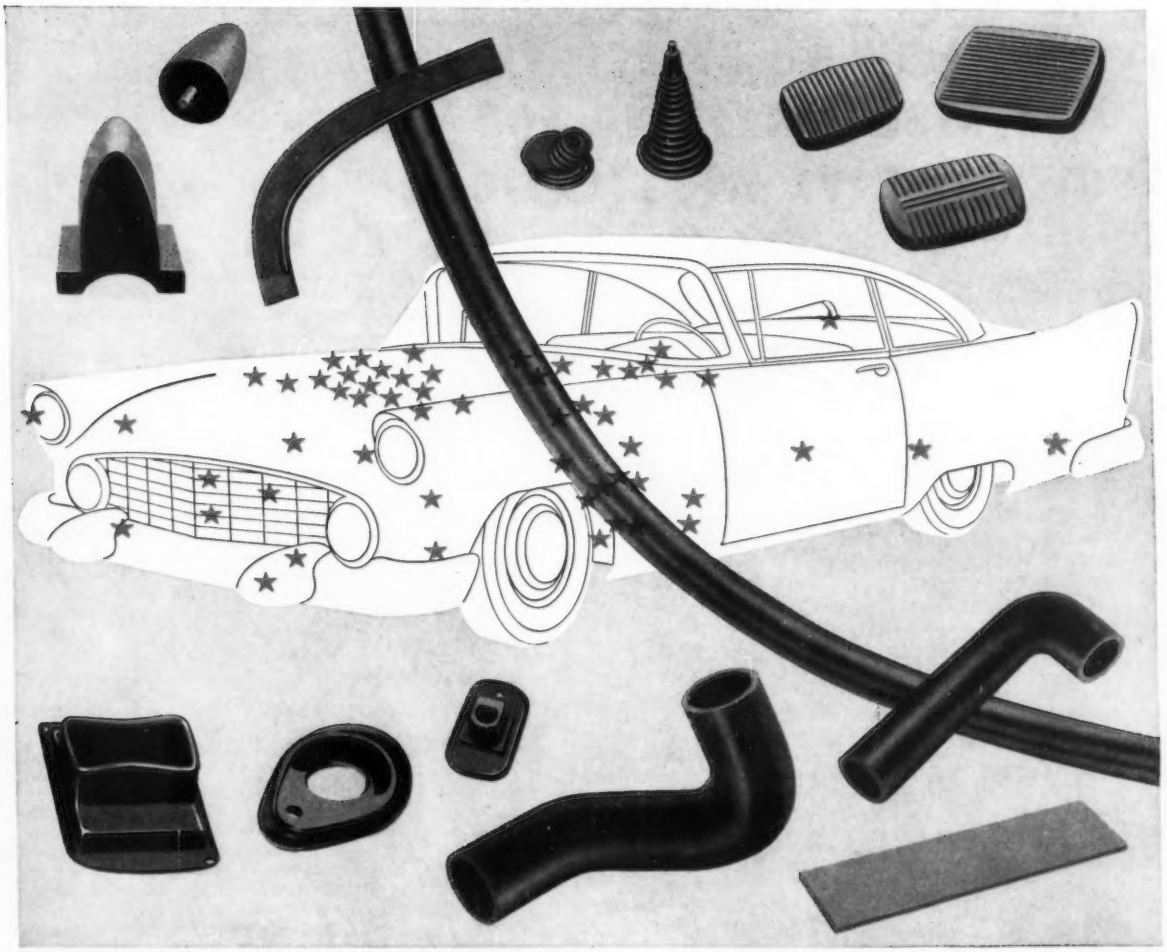
ASTM Standards on Petroleum Products and Lubricants (with Related Information). Prepared by ASTM Committee D-2. Cloth or paper, 6 x 9 inches, 1096 pages. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Cloth $7.50; Paper $6.75.

This compilation includes tentative and standard methods of test, specifications, definitions of terms and classifications of petroleum products and lubricants with related information, including the report of Committee D-2 on petroleum products and lubricants, and proposed methods of test.

This book is published annually and is an aid to chemists and technologists in the petroleum industry.

Soil Use and Improvement, by J. H. Stallings, research specialist in the United States Department of Agriculture. Cloth, 7 x 10 inches, vii + 403 pages. Illustrated and indexed. Published by Prentice-Hall Inc., Englewood Cliffs, N. J. $5.95.

This book was prepared as a highschool text. It covers the historical results of uncontrolled erosion. The author explains the process by which erosion takes place. This is related to the physical changes which must be brought about to achieve control. The application and effectiveness of control practices are explained in terms of what is accomplished by each. The book also traces the operation of the conservation movement in United States.



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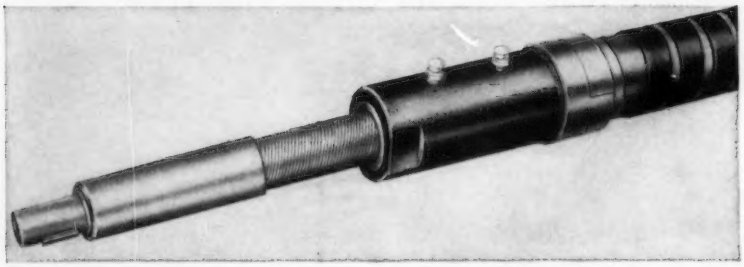
HOW TO SELECT FLEXIBLE SHAFTING FOR POWER DRIVE APPLICATIONS



1¼-inch STOW Power Drive flexible shaft with core assembly pulled out of casing.

For Power Drive applications, the following factors must be considered:

1. Torque (Lb. In.) to be transmitted. (The starting torque should be used in making selections).

2. Operating Speeds (RPM)—If the maximum speed is higher than the rated speed, torque ratings in the table below do not apply. To find the torque capacity for flexible shafts operating at speeds higher than the rated speeds, multiply the maximum dynamic torque capacity by the rated speed, and then divide by the operating speed. (See example).

3. Operating Radius—In making the selection from the table below, the radius of the smallest bend in the flexible shaft should be used.

Ratings — The ratings for flexible shafts shown in the table below apply under the following conditions:

1. When the flexible shaft is adequately supported by clamps along its length. (For unsupported shafts, multiply the calculated torque by a safety factor of 1.6—see example below)

2. When the flexible shaft is operated in the wind-up direction, which tends to tighten the outer layer of wires. (Flexible shafts operated in the unwind direction will transmit only about 60% of the rated torque).

3. When the flexible shaft is in continuous operation. Note: **the ratings are based on temperature rise. When the operation is intermittent, the ratings in the table may be exceeded. Consult Stow Engineers for specific recommendations.**

RATED SPEED R.P.M.	MAXIMUM DYNAMIC TORQUE CAPACITY (LB. IN.) STRAIGHT AND CURVED SHAFTS RADIUS OF CURVATURE IN INCHES									Wgt./ C. Ft.	Core Dia.	Core No. and Type	Shaft Size
	50 to Strgt.	25	20	15	12	10	8	6	5				
4,500	2.4	2.2	2.0	2.0	1.92	1.9	1.7	1.5	1.25	3.0	.124/.128	2049 MH	13
3,800	7 0	6.4	6.0	5.8	5.4	5.0	4.6	3.6	2.0	4.5	.148/.152	2081 MH	15
2,900	9.4	8.6	8.0	7.6	7.0	6.6	6.0	4.8	3.4	7.0	.185/.189	5108 MH	19
2,500	22.0	20.0	18.8	17.6	16.0	15.0	12.6	10.8	9.0	12.5	.247/.252	8924 MH	25
1,800	30.0	28.0	26.4	25.0	23.0	21.0	18.0	14.0		20.0	.308/.313	8925 MH	31
1,800	33.8	31.5	29.7	28.1	25.9	23.6	20.2	15.8		20.0	.308/.313	8969 T	31
1,800	36.0	33.0	31.6	30.0	28.0	26.0	22.0	18.0	11.0	21.0	.324/.329	2034 A	31
1,500	80.0	66.0	63.0	58.0	51.0	46.0	37.0	22.0		28.5	.368/.374	2035 A	38
1,500	60.0	54.0	50.0	46.0	42.0	38.0	30.0	24.0		29.0	.387/.393	8970 MH	40
1,500	90.0	81.0	75.0	69.0	63.0	57.0	45.0	36.0		29.0	.387/.393	8971 T	40
1,150	136.0	110.0	104.0	94.0	80.0	72.0	56.0			50.5	.497/.503	8999 A	50
1,150	148	124	110	92	72	56				53.5	.505/.511	6940 T	50
900	248	200	176	124	84					78.5	.610/.618	6997 T	63
900	220	204	192	180	152	130				80.5	.630/.638	7731 A	63
750	340	224	156	76						117	.747/.753	2056 T	75
600	760	520	420							205	.998/1.004	2057 T	100
440	1,500	720								343	1.298/1.304	2058 T	125

EXAMPLE — How to use the table:

The problem is to transmit ½ H.P. at 1700 RPM through an unsupported flexible shaft in a 25" radius, estimated starting torque 150% of normal operating torque.

1. Calc. Torque (lb. in.)—

$$\frac{HP \times 63000}{RPM} = \frac{.5 \times 63000}{1700} = 18.5$$

2. Correction factor for starting torque 1.5 x 18.5=27.75

3. Correction factor for unsupported shaft 27.75 x 1.6 = 44.4 lb. in.

4. Refer to Table No. 1, Read downward in column under 25" radius until you find a core having a rating of at least 44.4 lb. in. In this case we find that core No. 8970 is rated 54 lb. in. at 1500 RPM. Since the given speed is 1700 RPM, multiply 54 by 1500 and divide by 1700.54 ×1500 ÷ 1700 = 47.6 lb. in. (rated torque at 1700 RPM). Therefore, Core No. 8970 is correct.

STOW

For Engineering Bulletin No. 570 and a free torque calculator, write

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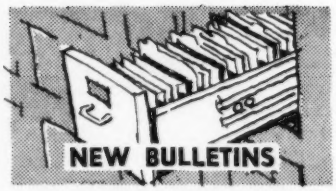

How to Dry and Store Grain and Seed on Georgia Farms, by J. W. Simons. Georgia Agricultural Experiment Station, University of Georgia College of Agriculture, Athens. Bulletin N.S. 33.

The first section of this bulletin is written in a question and answer form. It provides answers for questions on why dry and store grain and seed on the farm; how early can grain be harvested for mechanical drying; how dry should grain, ear corn and seed be to store safely; how can the moisture content of grain and seed be determined, and which method of drying should be used, etc.

The latter part of the bulletin explains how to build a safe storage structure. It discusses insect control and includes an appendix for determining moisture content of grain and seed, how to figure pulley sizes for fans and motors, and how to figure number of bushels in a bin (or crib) of corn, grain or seed.

Planning a Farm Shop Layout, prepared by G. E. Henderson, coordinator, and C. E. Turner, illustrator, Southern Association of Agricultural Engineering and Vocational Agriculture (September, 1956).

This 48-page booklet points out that the farmer today produces more than in years past because of the use of power equipment. It also explains that this equipment needs to be kept in good running condition and to do this a convenient place must be had in which to keep tools and to do repairs. The booklet includes sections on whether to build a farm shop, what type of shop to build, where to locate the shop, how to arrange different types of working areas, what heating system to install, etc.

Copies of this booklet may be obtained for 75 cents by writing to the Southern Association of Agricultural Engineering and Vocational Agriculture, Barrow Hall, Athens, Ga.

Tiered Air Duct Hay Drying Systems, by W. L. Kjelgaard, P. M. Anderson, E. F. Olver and A. W. Clyde. Progress Report No. 156, September, 1956, Pennsylvania State University, Agricultural Experiment Station, University Park.

This 8-page bulletin reports on the results of the tiered air duct hay drying system as tested by the experiment station. Different methods are discussed and illustrated with the inherent problems encountered.

Advantages and disadvantages of a tiered duct system are listed and it was found that an important feature was its flexibility because of being able to open and close ducts and to increase or decrease the air supply by the use of one or two fans. Results indicate that air distribution was improved to upper hay levels where the hay depth exceeded the side thickness. Lateral ducts extending towards the mow corners from the main duct improved air distribution in corner areas. Power consumption was reduced and hay quality of the cured hay was said to be improved from previous tests.

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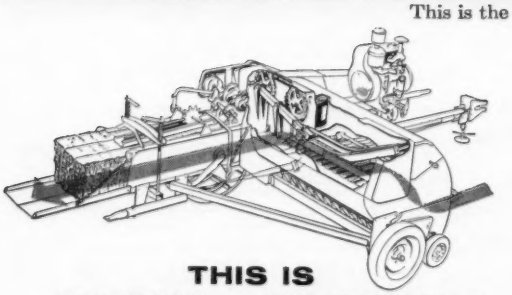
This is the new HAYLINER 68 with panel removed to show Flow-Action at work



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The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Austin, William E.—Hydraulic eng., (SCS) USDA, State College, Raleigh, N. C., P.O. Box 5126.

Carlson, Ernest A.—Supt. of mfg., Farmall Works, International Harvester Co. (Mail) 1119 14th Ave., Moline, Ill.

Carlson, Theodore H. — On duty with U.S.A.F. (Mail) Rollin Home Trailer Park, Mission, Tex.

Carra, Emil F., Jr.—Design eng., International Harvester Co., Broadview, Ill., (Mail) Y.M.C.A., 255 South Marion, Oak Park.

Cook, Preston K.—Agr. eng., (SCS) USDA, Bay City, Tex. (Mail) 2601 Avenue I

Cooper, Stanley W. — Temporary colonial officer, (experimental technician), National Institute of Agricultural Engineering, Seaford, England (Mail) Box 95, Eldoret, Kenya, East Africa.

Fernandes, Joao Ondas De Oliveira—Agr. engr., Lisbon Fresh Water Supply, Ltd., Lisbon, Portugual (Mail) Rua Barao de Sabrosa, 213.

Garrison, Duke A.—Asst. to vice-president, Russell, Burdsall & Ward Bolt and Nut Co., 224 S. Michigan Ave., Chicago, Ill.

Ghenn, Lyndle G.—Chief engr., R. H. Pierce Mfg. Co., 245 Blair St., Eugene, Ore. (Mail) 173 Clinton Drive.

Giese, Milton K.—Proj. engr., Farmhand Co., Div. Superior Separator Co., Hopkins, Minn. (Mail) 4800 Winterset Dr.

Goodwin, Benjamin F. — Secretary-treasurer and general manager, A. D. Goodwin & Son, Inc., R.R. 1, Box 126, Manteca, Calif.

Gordon, LeRoy T. — District mgr., Fafnir Bearing Co., 1907 Seventh Ave., Moline, Ill.

Gustafson, Axel C. — Consultant, DeLaval Separator Co., Poughkeepsie, N. Y. (Mail) R.R. 3, Weston Rd., Georgetown, Conn.

Haupt, Eugene J.—Designer, New Holland Machine Co., New Holland, Pa. (Mail) 512 S. Pearl St., Lancaster, Pa.

Henderson, Jerald M. — Graduate student, Iowa State College, agr. engr. dept., Ames, Iowa.

Houston, Robert K.—Design engineer, Food Machinery & Chemical Corp., P.O. Box 760, San Jose 6, Calif. (Mail) 1759 Hester Ave., Apt. 4.

Hudek, Edward P.—Agricultural extension engr., Extension Service, Manitoba Dept. of Agriculture, 153 Legislative Bldg., Winnipeg, Manitoba, Canada.

Kesler, David A.—Sales engineer, Mountain States Irrigation Co., Calhan, Colo.

King, Jerry B. — Engineer, (SCS) USDA, Box 312, Plainview, Tex. (Mail) 608 Vernon St.

Link, David A.—Instructor; agr. eng. dept., Iowa State College; Room 107, A.E. Bldg., Iowa State College, Ames, Ia.

(Continued on page 268)

Allis-Chalmers Stretches Farm Dollars with Thermoid Rubber Products

On "ALL-CROP" Drills, built by Allis-Chalmers, with *Thermoid Band Seeders* attached, farmers save up to 50% on seed costs, and get 28% more yield. Accurate seed placement *behind* the disc openers insures close-to-surface germination. Increased yields of hardier, more drought-resistant grasses and legumes have been reported—in many cases at savings of more than $5.00 an acre on seed costs alone! And, by using this method, fertilizer feeds the seeds—not the weeds!

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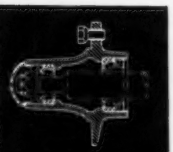
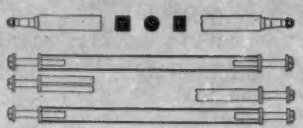


Four bolt series for light implements



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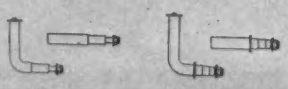

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. . . Applicants

(Continued from page 266)

Maharrey, Joe T.—Parts supervisor, Florida Ford Tractor Co., Jacksonville, Fla. (Mail) P.O. Box 1258.

Mann, Horace L.—Farm field engineer, Portland Cement Assn., 1528 Walnut St., Philadelphia, Pa. (Mail) 712 Franklin St., State College, Pa.

Martin, Larry—Partner, Martin Ranch, Box P, Marmarth, N. D.

Moore, Homer C.—Agricultural engineer. (SCS) USDA, Room 205 County Court House, Pocatello, Idaho.

Perritt, Robert E.—Service supervisor, International Harvester Co., 409 Lock St., Cincinnati, Ohio (Mail) 7658 Beechmont Ave.

Pike, Rexford C. — Technical representative, E. I. duPont De Nemours & Co., Inc., (Mail) Textile Fibers Dept., 1315 Grant Ave., Wilmington, Del.

Sewell, Ronald P.—Partner, R. P. Sewell & Co., Bacchus Marsh, Victoria, Australia

Vavra, Martin E. — Agricultural engineering specialist, (SCS) USDA, Box 930, San Angelo, Texas (Mail) Box 364.

Watt, Malcolm G.—Design engineer, tractor & implement div., Ford Motor Co., 2500 E. Maple Rd., Birmingham, Mich. (Mail) 106 Geneva Ave., Highland Park, Mich.

Transfer of Membership

Baker, Walter, Jr. — Senior agricultural engineer, Alabama Power Company, 600 North 18th Street, Birmingham, Ala. (Affiliate to Member)

Barnett, A. P. — Agricultural engineer, USDA, SWC, Beltsville, Md., (Mail) Barrow Hall, University of Georgia, Athens. (Associate Member to Member)

Bland, Hal E. — Sales manager, Aeroglide Corp., 510 Glenwood Ave., Raleigh, N. C. (Associate Member to Member)

Bryan, Ludwell B. — Electrical engineer, Public Works Dept., U.S. Naval Air Sta., Olathe, Kansas (Mail) R.R. 1, Gardner (Associate Member to Member)

Dixon, John E. — Instructor, research, University of Idaho, Agr. Engr. Dept., Moscow, Idaho. (Associate Member to Member)

Leggett, A. M. — District agricultural engineer; TVA, Box 401, Tupelo, Mississippi (Associate Member to Member)

Taff, Ernest T.—Asst. Chief Engr., Rome Plow Company; Cedartown, Ga. (Associate Member to Member)

. . . ASAE Sections

(Continued from page 254)

Minnesota Section

A meeting of the Minnesota Section was held February 7 at Coffman Memorial Union, University of Minnesota, Minneapolis, with 70 in attendance. A chicken dinner was served after which a short business meeting was held.

The remainder of the evening was devoted to a panel discussion on wheel track planting of corn. Boyd Forrest, SCS, North Branch, Minn., discussed yield studies; Orville E. Hays, supervisor, ARS, LaCrosse, Wis., discussed intraplanting, soil and water losses; George Blake, associate professor of soils, University of Minnesota, talked on field results and soil structures; and Robert R. Roth, project engineer, tillage tools, Minneapolis-Moline Co., discussed machinery problems. Following their formal presentations, the group answered questions from the floor.

You Can't Beat
GALVANIZED
Roofing & Siding

FOR BEST VALUE, buy *Grade-Marked* sheets, which show weight of zinc coating. And for longer, stronger service, specify heavy-coated roofing and siding such as the "Seal of Quality" . . . With *galvanized* sheets, you get the *strength* of steel, the *protection* of zinc. Preferred by thousands of users. Proved by time itself. Feature by feature, they're your *best buy.* Check and compare with any other material!

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

	GALVANIZED SHEETS	ANY OTHER MATERIAL
STRUCTURAL STRENGTH and rigidity; withstand rough treatment	YES	
YEARS OF RUST-FREE SERVICE; little or no upkeep problems	YES	
EASIEST TO HANDLE, lay and nail; stay put, hold at nail-holes	YES	
LIGHTNING PROTECTION, fireproof, ratproof, pleasing appearance	YES	
LOW COST ALL THE WAY, to buy, to apply and thru the years	YES	

FREE! "DO-IT-YOURSELF" MANUALS

Write: AMERICAN ZINC INSTITUTE
324 Ferry Street
Lafayette, Indiana Dept. AE4

☐ Facts About Galvanized Sheets
☐ How To Lay Galvanized Sheets
☐ Metallic Zinc Paint for Metal Surfaces

NAME_____
ADDRESS_____
CITY & STATE_____

For more facts circle No. 2 on reply card

BURLAP BULLETIN

News about packaging and agricultural and industrial developments in burlap

The Bag Picture at the Hunterdon G.L.F.

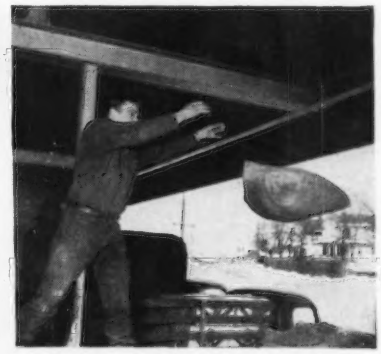
"Filling, stitching and tagging, burlap bags have more 'give' and can be dragged around," says Donald Washburn, Manager

of the Hunterdon G.L.F., Flemington, N. J. "We like the bag that doesn't have to be handled gently and stacks without slipping.

Our men can work faster loading and unloading with burlap bags that are easy to grab and can be tossed without bursting.

Besides feed, we sell seed in burlap, too. See what a neat, strong package this bag of seed oats makes. No tearing—no spilling.

This is grist that our dairy farmers have brought in which we have ground and mixed with molasses. We're here to serve



the farmer and he likes to get his supplies in the bag that's *tough;* and, thanks to our return bag system, is the most economical."

Says Henry Bundt (left), poultryman of Lebanon, N. J., "I get my feed at the Hunterdon G.L.F. in *burlap bags*. Then I return the empties and get credit for each. Our feed bags are tossed in the truck, dragged around and carted out to the chicken houses. Burlap bags can sure take rough handling."

For operating efficiency burlap bags save time and trouble. For economy, a return bag system is *the key to lower feed costs*. If there is no return bag plan in your area write to The Burlap Council, 155 East 44th Street, New York 17, N. Y.

Published by THE BURLAP COUNCIL of the Indian Jute Mills Association

For more facts circle No. 45 on reply card

So much depends on Bearing performance you can't afford to be without . . .

SEALMASTER

QUALITY!

Only SEALMASTER® OFFERS YOU THESE PATENTED FEATURES!

Flange design of retainer traps grease—eliminates "churning," assuring proper lubrication of balls.

Land ridden retainer floats on ground inner surface of outer race—minimizing ball and retainer wear.

Patented centrifugal, felt-lined flinger sealing principle keeps lubricant in, dirt and dust out.

Farming today, with modern machinery that lightens labor, saves steps and increases efficiency is a far cry from the pitchfork and hand plow agricultural era of yesterday. Yet, despite the high degree of mechanization and modernization, some farm machinery manufacturers still fail to take advantage of the benefits of anti-friction sealed bearings. Shafts still turn in simple sleeve bearings or even wooden blocks, resulting in inefficient power transmission and permitting dust and dirt to cause complete breakdowns.

SEALMASTER Ball Bearing Units with their exclusive combination of features insure outstanding performance and long bearing life. For quality you can depend upon, consult your Sealmaster representative or distributor soon.

Write for Bulletin 454 for full information.

SEALMASTER BALL BEARING UNITS

SEALMASTER BEARINGS A DIVISION OF STEPHENS-ADAMSON MFG. CO. • 67 RIDGEWAY AVE., AURORA, ILLINOIS

If you are not a member of the American Society of Agricultural Engineers and want (1) to subscribe* to AGRICULTURAL ENGINEERING or (2) to receive information about ASAE membership—or if you *are* a member of ASAE and want to propose the names of one or more prospective members — then simply fill out and mail the card at the right.

(*NOTE: A subscription to AGRICULTURAL ENGINEERING is included in the annual dues of each ASAE member.)

CHECK

☐ I want to receive AGRICULTURAL ENGINEERING regularly. Enter my subscription for one year ($5.00 in USA; $5.50 in Canada; $6.00 elsewhere). Payment is enclosed.

☐ I would like information about membership in the American Society of Agricultural Engineers, including an application form. (I understand that a subscription to AGRICULTURAL ENGINEERING and a copy of AGRICULTURAL ENGINEERS YEARBOOK are included in the annual dues of ASAE members.)

☐ I am an ASAE member and suggest that membership information, including application form, be sent to the name and address below. I can supply names of _____ more prospective members. My name is _____

Name _____

Position or title _____

Address (☐ Home or ☐ Business) _____

City _____ Zone _____ State _____

Employed by _____

Use the card *below* for free data on new products and the card *above* for subscribing to AGRICULTURAL ENGINEERING, or for requesting information about membership in the ASAE.

LET US KNOW YOUR WANTS

Kindly have mailed to me, without obligation, more information about items in this issue indicated by the numbers circled below:

APRIL 1957

→ *Please print or type your name, etc., below* ←

Your name _____

Your position or title _____

Name of employer _____

Address of employer _____

City _____ Zone _____ State _____

New Products, New Catalogs, and Advertisements in AGRICULTURAL ENGINEERING

1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100

Do you want more data or other information on products or catalogs advertised or otherwise featured in this issue? Then fill out one of the two mailing cards at the right and drop it in the mail today.

Our "Reader Information Service" clerks will see that your wants are promptly transmitted to sources of materials requested.

Postage Will Be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

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P. O. Box 229
St. Joseph, Michigan

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BUSINESS REPLY CARD
First Class Permit No. 1 St. Joseph, Mich.

American Society of Agricultural Engineers
P. O. Box 229
St. Joseph, Michigan

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Use the card *below* for free data on new products and the card *above* for subscribing to AGRICULTURAL ENGINEERING, or for requesting information about membership in the ASAE.

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Your position or title_____

Name of employer_____

Address of employer_____

City_____ Zone_____ State_____

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3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98

Do you want more data or other information on products or catalogs advertised or otherwise featured in this issue? Then fill out one of the two mailing cards at the left and drop it in the mail today.

Our "Reader Information Service" clerks will see that your wants are promptly transmitted to sources of materials requested.

DU PONT

Better Things for Better Living
. . . through Chemistry

AGRICULTURAL MACHINERY NEWS

LATEST PROPERTY AND APPLICATION DATA ON

ZYTEL® nylon resin

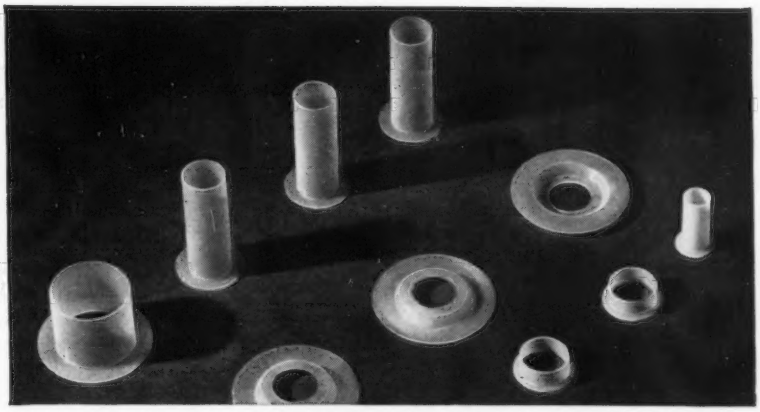
Bearings and bushings of ZYTEL® nylon resin are abrasion-resistant . . . need little or no lubrication

Tough, durable parts for agricultural machines made from Du Pont ZYTEL nylon resin stand up to rugged field work and often outperform metal parts they replace.

For instance, both gears and sleeve bearings of ZYTEL, tested in the presence of abrasive materials such as sand, outwear metal components by far. The load-carrying ability and temperature range of ZYTEL are approximately those of babbitt, with considerably better abrasion resistance.

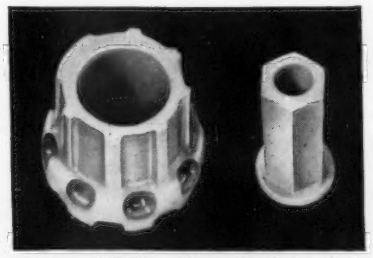
Under light loads, little or no lubrication is required for parts of ZYTEL. Operating with lubricant, simple sleeve bearings can support loads up to 1,000 lbs. per sq. in. at rubbing velocities up to 500 ft. per min. In one case, with only an initial lubrication, a bearing operated for 41 days without increase in temperature or torque.

Because of the resilience of the material, parts made of ZYTEL are quiet in operation, often damping or preventing the transmission of vibration to other components. Bearings of ZYTEL are resistant to pound-out. And components with thin walls, such as bushings, have high strength. Intricate shapes can be produced rapidly and economically to close dimensions by injection molding. And ZYTEL is rated for intermittent operation up to 250°F. For continuous operation at such elevated temperatures, heat-stabilized grades are available.

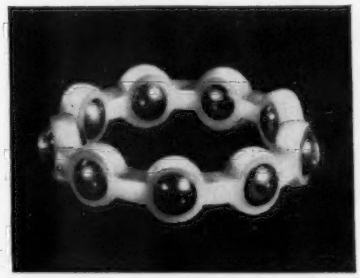


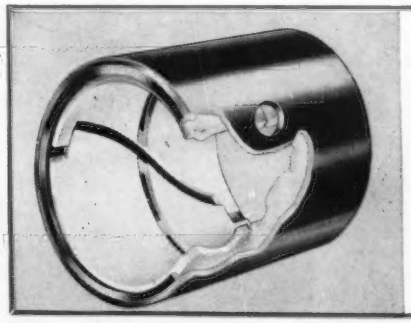
These brake-pedal bushings and window crank-handle bearing plates are made of ZYTEL. The parts give smooth, quiet operation and provide long-wearing bearing surfaces which, after assembly, do not have to be lubricated for the life of the vehicle.

Du Pont ZYTEL may be exactly the material you need to make hard-working machine parts. Send the coupon for free booklet. It contains scores of product ideas, showing how Du Pont ZYTEL has solved a variety of design problems.



Bearings of ZYTEL nylon resin shown above and ball retainer (below) feature excellent abrasion resistance, light weight, toughness in thin sections, heat resistance and resiliency.





UNIQUE BEARING utilizes a free-floating liner of Du Pont ZYTEL in a thin-walled sleeve of steel. This combination results in lower friction, quiet operation and reduced weight. Very often, lubrication requirements are satisfied when bearing runs in contact with liquids such as water or gasoline. (The bearing illustrated is one of many types of standard Nylined Bearings manufactured by Thomson Industries, Inc., Manhasset, N. Y.)

SEND FOR INFORMATION

Mail this coupon for additional property and application data on Du Pont ZYTEL nylon resin.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
Room 14, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont ZYTEL nylon resin.
I am interested in evaluating this material for_____

Name_____

Company_____ Position_____

Street_____

City_____ State_____

Type of Business_____

IN CANADA: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec.

Michigan State University to Serve as Host for ASAE "Golden Anniversary" Meeting, June 23-26

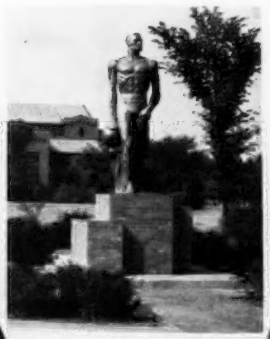
Beaumont Tower

The Agricultural Engineering building (left) and Animal Industries building (right) will provide facilities for many of ASAE program sessions

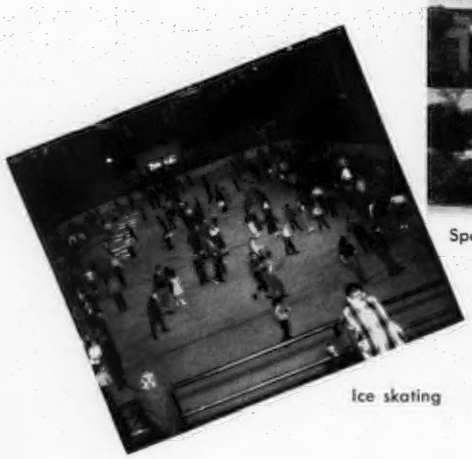
Shaw Dormitory, ASAE Headquarters for Golden Anniversary meeting

Michigan State University

America's first agricultural college
Founded in 1855
4000-acre campus and farms
America's ninth largest university
Over 17,000 students
2,350 different species of trees, vines and shrubs
Approximately 130 courses of study



Spartan statue symbolizes student spirit

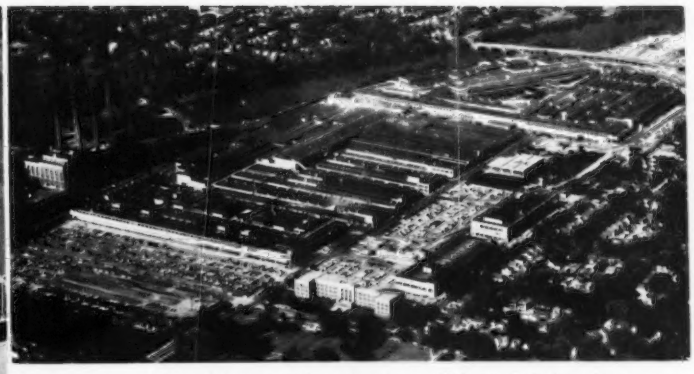


Ice skating

Canoeing

IN CANADA: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec.

Mackinac Straits Bridge (artist's conception) will be, when completed in 1957, the longest single-span suspension bridge in the world. It will span Michigan's upper and lower peninsulas



Oldsmobile main plant, Lansing, will be included in the many tours that have been arranged for ASAE members and friends

Michigan's Renowned "Water Wonderland" Provides Visitors with Rich Vacation Experience

An exact replica of Independence Hall in Philadelphia is located in Greenfield Village in Dearborn

11,037 blue water lakes

4,000 resorts

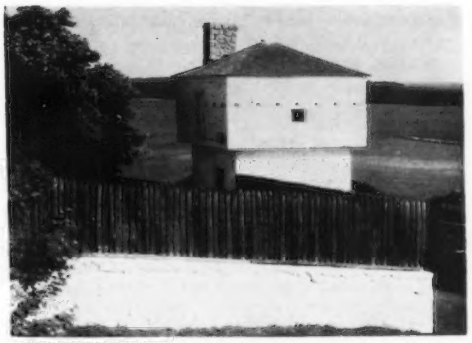
3,000 miles of shore line on the Great Lakes

36,350 miles of fishing streams

Historical sites

Automotive plants

Mackinac Straits Bridge



Old Fort Mackinac on Mackinac Island has been standing guard of the Straits of Mackinac since 1780

Plenty of water for swimming, boating and fishing

Pictured Rocks on Lake Superior shore

Inland lakes offer family fun

. . . News

(Continued from page 251)

Three Elected ASAE Fellows

The Council of ASAE recently elected J. H. Bodwell, W. E. Hudson and I. F. Reed to the grade of Fellow in the Society.

Joseph H. Bodwell was born at Hallowell, Maine, in 1891. He graduated from the College of Agriculture at the University of Maine in 1914 with a B. S. degree. He was the first county agent in Piscataquis County, Maine. Later he was county agent in Hampden County, Mass., and worked up to New England manager of the Allied Mills. He has been the director of rural service of the New Hampshire Electric Co., Portsmouth, since 1946.

Mr. Bodwell is known throughout the country for his pioneering work in the farm electric field, particularly for his work in promoting mechanical refrigeration on the farm, such as milk coolers, home freezers, and produce storage. He was secretary of the New Hampshire Locker Plant Association for two years and helped organize eleven locker plants in the state.

He is past-president of the New Hampshire Farm Electric Utilization Council, secretary-treasurer and past-president of Tri-County Electric Association, past-chairman of New England Farm Electric Service Committee of the New England Council, and past-chairman of New England Rural Electrification Institute. He joined ASAE in 1937. He has assisted in the development of electric projects for 4-H Clubs and other youth groups in New Hampshire. More recently his chief interest has been adequate wiring for the farm.

William E. Hudson was born in 1913 at Athens, Georgia. In 1935 he received a B.S. degree in agricultural engineering from the University of Georgia and later an M.S. degree. Following graduation he accepted a position as an instructor in agricultural engineering at the College of Agriculture, University of Georgia and in 1941 he became assistant professor.

After three years of service in the U.S. Army he returned to the University of Georgia as associate professor and in 1950 he became professor of agricultural engineering. He has worked on a research staff in the investigations of farmhouses and research structures, and barn hay drying system as applied to Georgia conditions. Since 1951 part of his time has been devoted to agricultural extension in preparing plans, specifications and supervising construction of farm structures at branch and college experiment stations.

Mr. Hudson is an active member of ASAE, having served on the committees on farm house standards and design, and professional registration. He became chairman of the latter in 1954-55. He has served as secretary and chairman of the Georgia Section of ASAE. He is a registered professional engineer and professional surveyor in the State of Georgia. He also has a rating of assistant agricultural engineer in the United States Civil Service Commission.

Irvin F. Reed was born in 1903 at Orchard, Nebr. He received a B.S. degree in agricultural engineering from the University of Nebraska in 1926, and an M.S. degree in agricultural engineering from the Ohio State University in 1928. In 1941 he earned his professional AE degree from the University of Nebraska.

After his graduation from Ohio State University he became assistant agricultural engineer for USDA, Pest Control Machinery, in Toledo, Ohio, until 1933 when he joined the Tillage Machinery Laboratory at Auburn, Ala. He has given long and faithful service at the laboratory to the development of basic information which has been of great value to the agricultural engineering profession, especially on soils dynamics, plow studies, soil compaction and traction of rubber tires on tractors. He has also contributed to the knowledge of harvesting of peanuts and the harvesting and processing of tung nuts and castor beans.

Mr. Reed joined ASAE in 1926 and has devoted considerable time in promoting the Society. He has been active in the Alabama Section both in its formation and activities. He is a member of Sigma Tau, Gamma Sigma Delta and the Masonic Lodge.

Materials Handling Exposition

The seventh National Materials Handling Exposition will be held at Convention Hall in Philadelphia, April 29 to May 3. The theme for the show will be "Materials Handling—Key to Automation." The science of handling is one of the major aspects to be studied to bring about the push-button factory of tomorrow.

Concurrently with the show the American Materials Handling Society will conduct a conference, April 30 to May 2.

PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin, the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level or proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listings.

POSITIONS OPEN — 1956 — SEPTEMBER — O-271-650, 305-651, 307-652, 292-653, 314-654. OCTOBER—O-330-655, 316-656. NOVEMBER—O-252-657, 363-658, 365-660, 365-661, 365-662, 382-663. DECEMBER—O-374-664, 374-665, 384-666, 385-667, 388-668, 394-670, 395-671, 396-672. 1957—JANUARY—O-414-675, 416-676, 453-677, 8-701. FEBRUARY—O-14-702, 14-703, 23-704, 23-705, 23-706, 12-707, 28-708, 38-709. MARCH —O-21-710, 52-711, 60-712, 45-713, 45-714, 81-715, 84-716, 70-717.

POSITIONS WANTED — 1956 — SEPTEMBER — W-359-30. OCTOBER—W-315-31, 323-33, 328-34, 332-35. NOVEMBER — W-255-36, 379-37. DECEMBER — W-366-40. 1957 — JANUARY — W-405-42, 413-43, 419-45, 422-46, 420-48. FEBRUARY—W-364-47, 13-1, 33-2, 10-3. MARCH —W-61-4.

NEW POSITIONS OPEN

DESIGN ENGINEERS (3) for creative design of earth moving, processing, feed handling and manure handling equipment with a major manufacturer in the Midwest. BSAE or BSME and ability in creative design engineering. Excellent opportunity for advancement in expanding engineering department of well established progressive manufacturer. O-90-718

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for design, development, research, sales, or service in farm structures or soil and water field with experiment station, manufacturer, processor, or farming operation, anywhere in USA. Married. Age 24. No disability. Available June 1. BSAE degree and BSA degree, 1955, University of Illinois. Farm background. Laboratory assistant with USDA on labor-saving feed and grain metering and distribution equipment over one year before graduation. Commissioned service in US Army Corp of Engineers 2 years. Salary $5,000. W-68-5

AGRICULTURAL ENGINEER for design, development, or research in power and machinery field, with manufacturer or processor, anywhere in USA. Willing to travel. Married. Age 26. No disability. Available August 1. BSAE, 1953, University of Idaho. Certificate of competence in meteorology, 1954, University of California. Farm background. Commissioned service in US Air Force for 4 years in meteorology. Student engineer with farm equipment manufacturer 3 months between graduation and call to active duty. Salary open. W-51-7

AGRICULTURAL ENGINEER for extension, sales, or service in rural electrification or products engineered for farm use, with college or manufacturer, anywhere in USA. Willing to travel some. Married. Age 30. No disability. Available now. BSAE. Farm background. Comissioned service in Army Signal Corps 18 months. Farm Electric service advisor for 18 mo. Other sales and service experience. Salary $6500. W-74-6

CLOSED DIE FORGED

PRONG

by

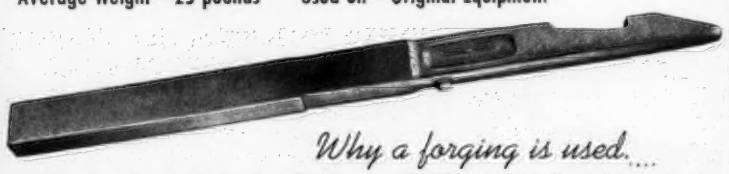
FARM TOOLS DIVISION

PITTSBURGH FORGINGS CO.

114 THORN STREET

CORAOPOLIS, PENNA.

Part Name—Hitch Prong
Average Weight—25 pounds
Material—C-1045
Used on—Original Equipment



Why a forging is used....

Here is a closed die forging that is versatile. The point is forged as a standard part but the opposite end behind the stop lug is furnished to customer specification. The variable part of this prong can be furnished in any length, drilled or not drilled, bent or not bent. Original equipment manufacturers can take advantage of our forging design knowledge. Let our forging engineers design closed die forgings for your farm equipment.

For more facts circle No. 34 on reply card

from plowing to harvest time

SPRAYING SYSTEMS

TeeJet®

SPRAY NOZZLES

SOIL FUMIGANTS

TeeJet Flow Regulators for depth application and surface streaming.

LIQUID FERTILIZERS

BoomJet Spray Nozzles . . . for broadcast application.

WEED CONTROL

TeeJet flat spray Nozzles, for uniform controlled coverage.

INSECT CONTROL

TeeJet Spray Nozzles with ConeJet or Disc Type tips.

•

Choice of over 400 interchangeable orifice tips for every farm need . . . and all accessory equipment, such as the boom control TeeValve, pressure relief valves, strainers and fittings. For complete information, write for Catalog 30.

SPRAYING SYSTEMS CO.

3226 Randolph Street • Bellwood, Illinois

A PROVED AND DEPENDABLE SOURCE OF SUPPLY

For more facts circle No. 36 on reply card

TRACTOR BOOK

Development of the Agricultural Tractor in the United States, Part I

By R. B. Gray, U. S. Department of Agriculture
$2.00 postpaid

This book (1) assembles in chronological order the events and dates relating to the establishment, merger, discontinuation, or reorganization of steam traction engine and gas tractor manufacturing companies, and (2) supplies brief specifications of many of the tractors they produced. The first section of the book (Part I) briefly discusses mechanical farm power, and the development of both wheel and track-type tractors up to 1919 inclusive. The book is profusely illustrated. Part II is in preparation by Mr. Gray, and will cover the period from 1920 to 1950 inclusive.

Order copies of Part I from

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
P.O. Box, 229, St. Joseph, Michigan

For more facts circle No. 37 on reply card

Experimental Farms that "GROW" CONCRETE to build a stronger America

Two of the strangest farms in America "grow" concrete in northern Illinois and central Georgia. They are Portland Cement Association experimental farms where scientists study the effects of weathering on concrete in northern and southern climates.

"Growing" here are better pavements for barnyards and feedlots—better foundations, floors and walls for farm buildings, schools, hospitals, factories and other structures vital to America's welfare.

"Plantings" made on the farms, starting in 1940, consist of rows of concrete slabs, posts and boxes which simulate pavements, structural columns and walls. Specimens contain varying proportions and combinations of materials used in making concrete.

Such research is a continuing activity of the PCA. Out of it comes technical data on the best concrete mixtures and construction practices for installations exposed to all conditions of service and weather. Knowledge gained is made public immediately and freely through PCA's field engineering, educational and promotional programs made possible by the voluntary financial support of its 68 member companies.

Thus data from laboratory and field tests can be quickly used by agricultural engineers and contractors in designing and building more durable, ***lower-annual-cost*** facilities to keep America strong.

PORTLAND CEMENT ASSOCIATION

33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of portland cement and concrete... through scientific research and engineering field work

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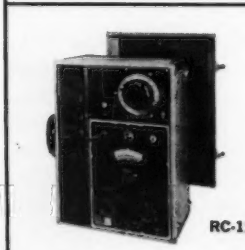
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FACTS

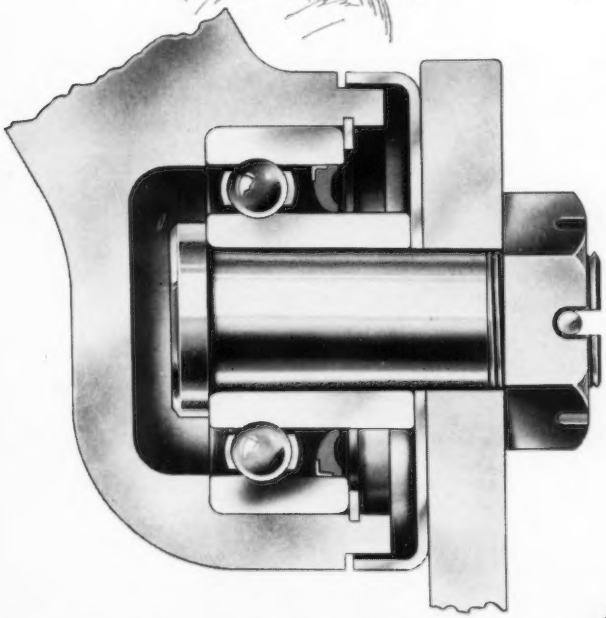
about

NEW DEPARTURE BALL BEARINGS

BEARINGS THAT THRIVE ON *Neglect*

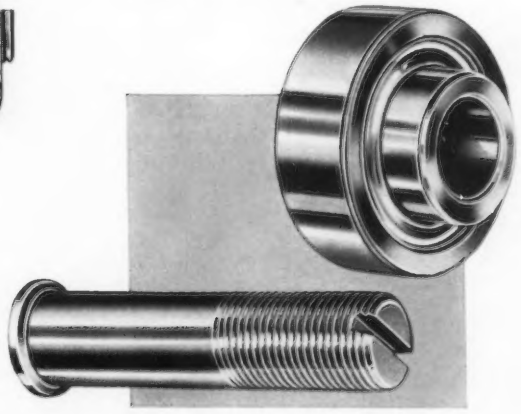
New Departure self-sealed ball bearings in farm machinery save the farmer *time*, *labor* and *lubricating cost*. But that's not all. They also give him *better-running—longer-lasting* equipment. That's because they are lubricated for life . . . reduce maintenance to zero.

These New Departures in hay rake tine bar bearings, for example, have been developed to give both implement manufacturer and user bearings that are easily applied. Once installed, they maintain their accuracy while handling heavy combination loads through years of rugged service. And, you'll find they can be entirely neglected—they are lubricated for life —are "built to be forgotten"!



These ball bearings are fully protected by flexible seal and metal slinger. An ample grease supply, kept free of contaminants, eliminates all need for relubricating. This means maintenance is zero.

Bearing bores are accurately sized to fit correctly on either standard machine bolts or on special stud shown. Bearings retained in tine bar end by simple snap ring. No drilling, tapping or threading required. Special studs available from New Departure.



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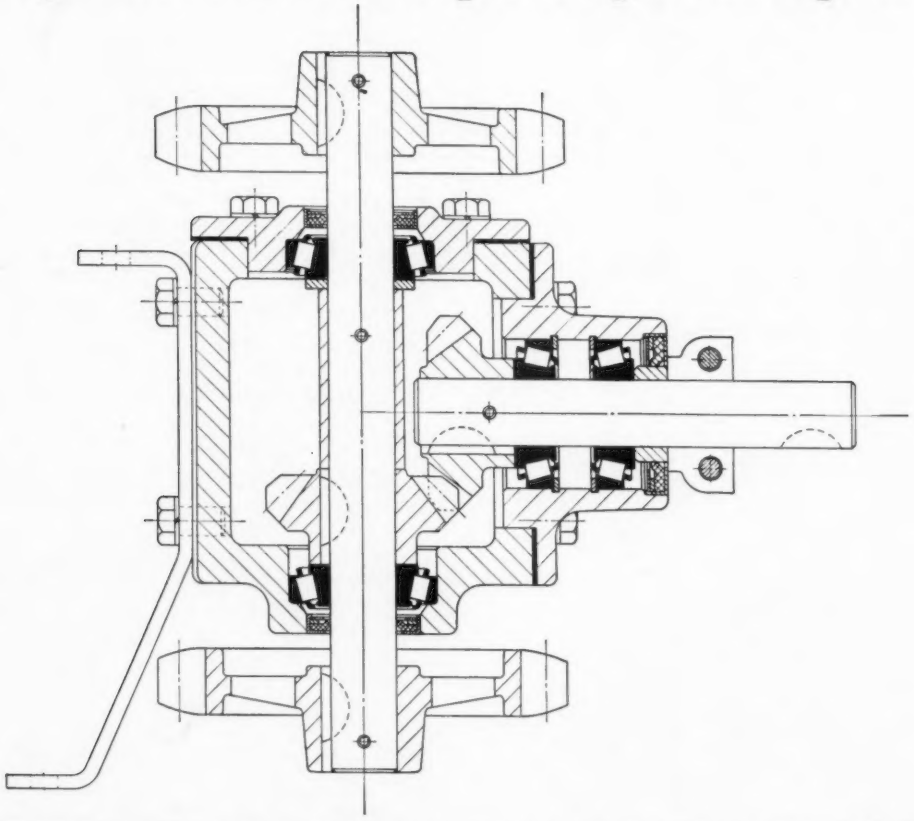
How Minneapolis-Moline keeps shafts aligned, lengthens life of corn picker gear box parts



ONE big reason for the longer life of moving parts in the Minneapolis-Moline Mounted Corn Picker is that the gear box is equipped with Timken® bearings.

Timken tapered roller bearings in the small gathering chain gear box hold shafts in rigid alignment because they take both radial and thrust loads in any combination. Gears mesh smoothly and accurately, wear less. It's the tapered construction that does it. And full line contact between rollers and races gives Timken bearings extra load-carrying capacity.

Because Timken bearings keep housings and shafts concentric, closures are more effective. Dirt and moisture can't get in. Lubricant can't get out. Maintenance is further reduced—one lubrication a season is usually plenty.

Timken bearings save power, too. That's because they practically eliminate friction. They're designed by geometrical law to have true rolling motion and are manufactured with microscopic accuracy to live up to their design.

With Timken bearings, agricultural engineers find ready answers to three of their biggest design problems: 1) combination loads, 2) dirt, 3) ease of operation. Engineers can depend upon Timken bearings to help equipment operate more easily and economically, last longer. We even make our own bearing steel, to be sure it's the finest available. We're America's only bearing manufacturer that does.

For helpful design ideas on applications for Timken bearings, write for your free copy of "Tapered Roller Bearing Practice In Current Farm Machinery Applications". The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

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